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ABSTRACT

This case study focuses on the impact of technology in the Peakview Elementary School (Colorado) which, in order to implement organizational and teaching strategies advocated by the school restructuring reform movement, installed more than 80 networked computers and related technology. The study relied on written surveys and interviews of teachers and students. Data were gathered at the beginning and end of the 1991-92 school year. Peakview was also compared with three other elementary schools. Findings are reported in the following areas: (1) use of technology, including prior experience, time factors, activities, use of media, use of hardware, use of multimedia, verbal and visual media, and equitable access; (2) impact on teaching, including changes in teacher work, ability levels, small-group instruction, competition versus cooperation, time on task, self-directed learning, multiple learning goals and styles, students as teachers, information access and research activities, and professional uses of technology; (3) implementation factors, including classrooms versus labs, computer coordinators, technical support, and taking computers home; (4) teacher attitudes, including student perceptions of teachers; (5) student achievement, including basic skills attainment, information access and use, problem-solving skills, communication skills, research and reporting, small-group work, and creativity; and (6) student attitudes, including student empowerment, attitudes of special needs children, and attitudes toward school, technology, learning, teachers, and self. (Contains 42 references.) (KRN)

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ED 366 288

# EVALUATING THE IMPACT OF TECHNOLOGY AT PEAKVIEW ELEMENTARY SCHOOL

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## THE FULL REPORT

Submitted to

Peakview Elementary School
Cherry Creek School District
Aurora CO

Submitted by

Brent G. Wilson
Roger Hamilton
James L. Teslow
Thomas Cyr

The Division of Instructional Technology
School of Education
University of Colorado at Denver
Denver CO

January 1993

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# SUMMARY OF THE REPORT

Clearly, something special is happening at Peakview Elementary School. Peakview is a new school that is implementing a number of organizational and teaching strategies advocated by the school restructuring reform movement. Among those strategies is the infusion of more than 80 networked microcomputers and related technology and software. This evaluation study examined the impact of the technology on the school community. Using a variety of data collection instruments (e.g., classroom observation, surveys and interviews of school personnel and students), we found consistent evidence that technology plays an essential role in facilitating the school's goals. The technology is positively affecting student learning and attitudes. Teachers are using the technology to adapt to individual students' needs and interests, and to increase the amount and quality of cooperative learning activities. Students use the technology extensively for research and writing activities, as well as for instructional support in a variety of subject areas. Technology has changed the way teachers work, both instructionally and professionally, resulting in a net increase of hours and at the same time greater productivity, effectiveness, and satisfaction. A number of implementation factors are identified as contributing to the success of Peakview's use of technology. These factors form the basis of a set of recommendations for implementing technology successfully in other schools.

# EVALUATING
# THE IMPACT OF TECHNOLOGY
# AT
# PEAKVIEW ELEMENTARY SCHOOL

# FULL REPORT

## Purpose of the Study

Peakview Elementary School opened its doors to students in the fall of 1991. From the outset, school staff intended Peakview to reflect concepts of school reform. Examples of innovative organizational strategies include multi-aging, teacher teams across grade levels, and a commitment to problem-solving and cooperative learning activities. A key component of the reforms was a greater role of technology to support classroom activities. A substantial investment in computer and video resources was made, resulting in more than 80 Macintosh computers available in the school, most of them distributed in the classrooms. Classrooms presently house an average of 4–6 color Macintosh computers each. This is a significant increase in the quantity and quality of computers typically available in elementary school classrooms. Technology products—including optical laserdiscs and computer-based instruction—have replaced science, social studies, and math textbooks.

Most of the reforms implemented by Peakview staff are structural in nature and do not require significant additional resources. The increased reliance on technology for instruction, however, constitutes a more costly reform. In spite of redirecting monies normally allocated towards textbook purchases, the net cost to the school is substantial. A question posed by school staff is:

- Is it worth it? Does the technology support the innovative structures and goals of the school?

A parallel question relevant to district decisionmakers is:

- Would the Peakview use of technology be a model worth disseminating to other elementary schools in the district?

These are questions of worth, implying a tradeoff between costs and benefits. Although the present study is not a formal cost/benefits study, the questions above are still pertinent. ***Our purpose in conducting the study was to evaluate the impact of technology on the school.*** Of particular importance is the role of technology in furthering the school reform initiatives being undertaken. That is, ***does the use of technology impede, afford, or even accelerate the effectiveness of the teaching approach being implemented at Peakview***? The findings of the study will evaluate the overall worth of the technology within the system; decisionmakers within the school and district should then be able to determine whether the added costs involved provide a justifiable return on investment.

## Background Trends

The study is being undertaken at a time when three general trends are converging in the schools:

1. ***Schools are being encouraged to undergo structural reforms and to look for new models of envisioning education.*** Examples of this trend are site-based leadership, multidisciplinary teaching teams, renewed emphasis on problem solving and critical thinking, and the middle school concept. Many of these reforms are based upon sound research on learning, classroom processes, and organizational design.

2. ***Advances in technology have opened up possibilities of improved delivery, management, and evaluation of instruction.*** Computer hardware and software continues on its steady move toward dramatically improved quality with costs holding more or less constant. As the technology grows in power and flexibility, its relevance to education increases, reflecting the growing role of technology in the workplace and in society generally.

3. ***Schools are being held increasingly accountable for student growth to justify investments and strategic direction.*** Many school districts are facing declines in their available revenues. Limited resources, coupled with indications that American students are not performing well in comparison to many other industrialized nations, have resulted in a felt need to find better methods for gauging student learning. Improved student assessment would provide a sounder basis for making instructional decisions and for judging the effectiveness of different instructional programs.

The teaching innovations at Peakview indicate the school district's willingness to develop alternative teaching models, and to incorporate advances in technology into these models. The present study attends to the question of assessing student growth; however, a continuing commitment needs to be made to performance-based assessment that will inform future decisions.

## The Study's Design

This is primarily a case study of Peakview Elementary School and its use of technology. A number of data-collection instruments were used to help provide valuable information concerning the school; these are discussed in the Method section below. The study relied heavily on written surveys and interviews of teachers and students.

The present study was designed and conducted to be a sort of "snapshot" of conditions at Peakview. To provide a context for understanding, comparison were made of two kinds:

***Beginning vs. end of school year.*** Survey data were collected at two different times: August 1991—one month after Peakview's opening—and May 1992, toward the end of the school year. This allows some perspective on changes over the course of the school year.

***Peakview versus other schools.*** To gauge in what respects Peakview differed from other schools in the district, three additional elementary schools were selected for comparison. Two schools were selected primarily for logistical convenience: Summit and Polton had staff members who were students within UCD's Division of

Instructional Technology. These staff members agreed to collaborate with us in conducting the research. Summit has a computer lab of Apple IIgs computers, and very few computers in individual classrooms. Polton also has a lab, with a few computers in classrooms. Parallel survey data were collected at these additional elementary schools; no other data were collected from these schools. Dry Creek was selected because it was perceived to be similar to Peakview in that computers were integrated into classrooms, but different because the computers were Apple II's rather than Macintosh computers.

## Scope and Limitations of the Study

In spite of our efforts to gather complete information, the study has several limitations.

1. ***Lack of longitudinal perspective.*** Schools change over time. Some innovations progressively gain steam as teachers and students come to value them and as they work out the bugs in implementing them. Others begin with fanfare but gradually fade away because problems in implementation are not addressed. Our study attempts to understand the impact of technology at Peakview in the present, but does not systematically review the progressive impact of the technology over a period of years. However, continuing collection of data by the school could be used in future years to assess trends and technology's impact across those years.

2. ***Lack of systematic performance measures.*** An obvious and serious limitation in the present study is its lack of direct measures of student achievement. The school is new, lacking data on standardized tests. Even when standardized test data become available, there are many problems in using them as a basis for isolating specific effects of technology. The district is presently developing competency-based measures of student writing, but these have not yet been incorporated into the school's assessment procedures. No other direct measures of student achievement are presently available for analysis.

   To partially compensate, a variety of data sources were used to gauge student learning, particularly:

   - teacher observations and perceptions indicated through surveys, interviews, and weekly logs;
   - student reports through surveys and interviews;
   - limited classroom observations;
   - selected student work samples.

   Individually, each of these data sources would be quite limited; collectively, though, the accumulated evidence may be persuasive if they are consistent with one another. This process of "triangulation" (i.e., approaching a question from multiple perspectives) is a key to the qualitative research process, and is incorporated throughout the study.

3. ***Integration of technology within total school process.*** The focus of the study is on technology; yet how can the effects of technology be sorted out from the total school process? This embeddedness and interdependency of a whole cluster of instructional strategies is the central fact of life at any school, and is particularly evident at Peakview. Teasing out effects attributable to the technology is a demanding task that perhaps requires more the perspective of an ethnographer than that of the "objective" test-giver. Researchers of such rich social systems need to follow trails of evidence and examine subtle perceptions of participants. Above all, the research team needs to be open to evidence from all available sources that can shed light on what goes on in the school.

# TECHNOLOGY IN THE ELEMENTARY SCHOOL: A LITERATURE REVIEW

Computers have been in the schools for nearly two decades. Over the years, a body of research and theory has emerged studying the role of computers in schools and in the learning process. This section offers a brief review of key ideas taken from that literature base.

## Learning Effects

Several reviews have established that computer-based instruction leads to a moderate increase in student achievement levels (Hasselbring, 1984; Neimic & Walberg, 1985; Bangert-Drowns, Kulik, & Kulik, 1985). Neimic & Walberg (1985) found an average effect size of .42 across all age levels, with the most pronounced effect found for low-ability students. Students attitudes have also been consistently positive toward computer-based instruction. Positive effects have been found for the use of traditional computer-based instruction, such as drills, tutorials, and simulations. There is some evidence to suggest that using computers as cognitive tools to support student work can also lead to learning gains; for example, the use of word processing programs can improve the writing process and product (Murphy & Appel, 1984; Jefferson County [Kentucky] School District, 1988). Many questions remain, however, concerning optimal uses of computers, and optimal ways to support teachers and students in that use.

## Shifts in Teaching Methods

Collins (1991), a noted cognitive psychologist, cited eight trends in changing teaching methods. These changes are supported by research in cognitive psychology. Collins notes that each of these changes in teaching method can be facilitated by technology. We have listed each trend below along with a brief comment relating the teaching method to technology.

| Traditional Teaching Methods | Technology-Assisted Methods |
|---|---|
| Whole-class instruction | Small-group instruction |
| Lecture and recitation | Coaching |
| Working with better students | Working with weaker students |
| Less engaged students | More engaged students |
| Assessment based on test performance | Assessment based on products, progress, and effort |
| Competitive social structure | Cooperative social structure |
| All students learning the same things | Different students learning different things |
| Primary of verbal thinking | Integration of visual and verbal thinking |

Table 1. *Trends toward constructivist teaching methods facilitated by technology (Collins, 1991).*

1. ***A shift from whole-class to small-group instruction.*** Gearhart, Herman, Baker, Whittaker, and Novak (in press) observed a dramatic decrease in teacher-led activities when computers are used, from 70% to less than 10%.

2. ***A shift from lecture and recitation to coaching.*** Again, Gearhart and colleagues (in press) found an increase in teachers serving as facilitators (rather than directors of behavior) when using computers, from 20% to 50% of class time. Collins (1991) comments: "The introduction of a third party, the computer, into the situation encourages the teacher to play the role of a coach, in much the same way that a piano encourages the teacher to play the role of a coach in a piano lesson" (p. 29). Schofield and Verban (1988a) found teachers using first-person constructions ("Let's try this") over second-person, didactic constructs ("You should do this") when using computers.

3. ***A shift from working with better students to working with weaker students.*** In traditional classrooms, teachers often carry on a conversation with brighter students who raise their hand; teachers often ignore slower students to avoid embarrassing them. With technology, that pattern is reversed: Schofield and Verban (1988a) found slower students receiving two to four times more attention from the teacher.

4. ***A shift toward more engaged students.*** A number of studies have demonstrated that students who work with computers exhibit greater task engagement, often to the point of fighting over computer between classes and after school. "To the degree that the computer supports long-term effort rather than short exer-

cises...students become invested in the activities they carry out on computer" (Collins, 1991, p. 30).

5. ***A shift from assessment based on test performance to assessment based on products, progress, and effort.*** Teachers have traditionally relied on end-of-unit tests for assessment. Technology shifts assessment efforts from tests to effort and progress on projects, and on the final product. This, of course, poses new problems for teachers as they search for meaningful and reliable ways of evaluating work products.

6. ***A shift from a competitive to a cooperative social structure.*** A number of researchers have noted greater cooperation among students when using technology. For example, Harel (1990) studied 4th graders as they developed their own lessons to teach fractions to 3rd graders. She found students naturally sharing ideas and helping each other solve problems in their programming.

7. ***A shift from all students learning the same things to different students learning different things.*** A number of studies have shown how technology can support students as they tackle various parts of a complex project, each contributing to a larger final product. What this means is that students are working on separate aspects of a problem. Students working on different learning goals can be a logistical nightmare without technology to maintain focus and manage information.

8. ***A shift from the primacy of verbal thinking to the integration of visual and verbal thinking.*** Visual media—television, film, and computers—have begun to gain parity with abstract text as a primary means of learning in our day. Lectures, multiple-choice tests, and recitation of knowledge become less relevant methods when faced with technology-based alternatives.

In other words, society in general and education in particular are coming to value a certain approach to education. There is some evidence that technology can help education practice move in those valued directions. This line of thinking influence the design of the present study; the reasoning was: Technology can be justified to the degree that its use is found to facilitate instructional methods and learning goals that are valued by the school and/or the district.

## Computer-Intensive Environments

For several years, Apple Inc. has sponsored a research program called the Apple Classroom or Tomorrow (ACOT), which endows schools with generous gifts of computer resources, then observes the effects of the technology on the teaching and learning process. The ACOT research sheds light on what happens when schools receive large numbers of Apple computers; this has obvious relevance to the Peakview situation. Generalizing across ACOT projects, Apple staff (Dwyer, Ringstaff, & Sandholtz, 1991) have observed five general phases of implementation, summarized below. These phases occurred in different schools dating back to 1986.

1. *Entry phase.* In this initial phase, teachers "struggled valiantly to establish order in radically transformed physical environments" (Dwyer, et al., 1991, p. 47). With the expected problems of beginning a school year—discipline, resource management, organization—having the added problems and benefits of computers was definitely a mixed blessing for some teachers:

> *If I had my druthers, I don't think I would ever look at a computer again. One of my students got into the network and lost lots of information because he doesn't know what he is doing....There are so many variables like this that we deal with on a day-to-day basis that I didn't anticipate being part of this program. I'm anxious for the weekend so I don't have to do anything with computers.* (p. 47).

2. ***Adoption phase***. Once teachers had recovered from the initial shock, the technology began to be integrated into the traditional classroom. Even though the arrangement was very different physically, traditional teaching methods—drill-and-practice, text orientation, whole-group lectures, seatwork—predominated. Student attitudes were high, and teachers reported individual student effects, but overall student achievement was basically unchanged.

3. ***Adaptation phase***. At this phase, traditional teaching methods were still in place, but they were consistently supported with computer activities, particularly the use of word processing, database, some graphics programs, and computer-based instruction. Productivity and efficiency were the salient changes reported by teachers; for example, a computer-based math curriculum allowed 6th graders to finish in 60% of the time normally required. One teacher comments:

   > *Students are writing with a great deal more fluency now, thanks to keyboarding skills. Following a prewriting exercise, they now type their stories directly into the computer, rather than writing out the whole story and then copying it.*

   Students became enthusiastic about computer tools:

   > *On Monday, when I announced that it was time for recess, the students wanted to continue to work in the classroom. One said, "You know, I can't believe it's really recess. When you're having a good time, time goes by so fast." They are really involved....They work really quietly without a lot of running around.* ***They seem to be setting up standards for themselves to judge their own work.*** (p. 48, emphasis added)

4. ***Appropriation phase***. This phase began in the second year of a project. "The change hinged on each teacher's personal mastery—or appropriation—of the technology" (p. 48). The teacher's increasing confidence in the technology, and time with the technology, resulted in more innovative instructional strategies. This phase was marked by "team teaching, interdisciplinary project-based instruction, and individually paced instruction" becoming more common at the sites. As an independent observer noted:

   > *The interactions of children at computers were different. Specifically, the students talked to each other more, they frequently asked for assistance from their neighbors, they were quick to interrupt their own work to help someone else, and they displayed tremendous curiosity about what others were doing.* (pp. 49–50)

   Reported a district technology supervisor, "Our teachers are learning to be facilitators rather than the total dispensers of knowledge. Everyone benefits" (p. 50).

   > *An interest aspect of this phase is that newcomers to the projects progressed up to this phase in their first years, suggesting the value of the culture of experienced teachers already at the site.* (p. 50)

5. ***Invention phase***. This phase is less an actual phase than a mindset, implying a willingness to experiment and change. "Today, the staff of ACOT's classrooms are more disposed to view learning as an active, creative, and socially interactive process...Knowledge is now held more as something children must construct and less like something that can be transferred intact" (p. 50). One teacher noted her change in attitude:

    *As you work into using the computer in the classroom, you start questioning everything you have done in the past and wonder how you can adapt it to the computer. Then, you start questioning the whole concept of what you originally did.* (p. 50)

    The use of computers thus serves the role of *change agent* within the classroom environment, affording and stimulating reflection, redesign, and change.

In a separate research report, the same authors (Ringstaff, Sandholtz, & Dwyer, 1991) noted some additional trends:

***Utilizing student expertise***. Students immediately began helping each other, at first on their own initiative, later with the teacher's encouragement. Teachers began encouraging their gifted children on special projects or as "teachers," sharing their knowledge with classmates. As their use with the technology increased, however, the value of "slower" students as teachers was recognized:

> *During book editing time, Shelly finished the book and just very naturally went over and started helping Tom. He had messed up part of his book. She just went over to help and did a nice job. She's very limited herself, but it is interesting how limited some of these kids are and yet how they collaborate with others on projects. They do it very naturally and do a nice job on it.* (p. 9)

Another ACOT study (Gearhart, Herman, Baker, Novak, & Whittaker, 1990) found that students who excelled at peer tutoring or at sharing technological expertise typically were *not* the top students in the class.

Teachers who were initially reluctant to allow students assume the teacher role eventually became convinced of its value for all students:

> *Joe is the talkative, annoying, misfit kind of kid which every teacher has had at some time. He loves the computer. He has not been popular with his peers, but he has caught on very quickly to Pascal. Other students are asking, "Can Joe come over and help me?" It is interesting to see how becoming an expert has influenced his class relationships.*
>
> *I had a good breakthrough with one of my students today....The kids were using LogoWriter to do a basic outline of the state of Tennessee. East and west boundaries of Tennessee are very irregular and the kids were having a lot of trouble doing it. Lee figured out how to do it with shape tables....It was a novel solution to this problem....Lee is not a "breakthrough" kind of kid ordinarily. There's something there that I've never been able to pull out before....I was proud of him.* (p. 9)

Teachers also noted two trends in students sharing their expertise: (1) students began to share their expertise with people other than their peers, and (2) teachers began allowing student-to-student teaching of nontechnological content.

***Expanding the audience.*** As students' expertise in technology grew, the demand for them to share that expertise grew. Students commonly taught their parents how to use the computer at home. One site even reported children using the computer to help their parents learn to read. Other audiences included

- younger students
- administrators
- retired community members
- other teachers
- substitute teachers
- shopping malls
- state fairs
- state and national conferences
- industry symposia
- congressional subcommittees (!)

One school district "hired students as technical support people to help with setting up equipment and as teaching assistants in summer courses for district personnel" (p. 10). High school teachers began taking students' active roles for granted, forgetting how rare such things typically are in the schools:

> *What impressed our visitor the most was all the teachers coming into the room, taking the handouts and watching the [students'] presentations [on computer application] and really learning something. We're so used to [student-led presentations] now, we just assume that a teacher who wants to learn would take advantage of these presentations, but [the visitor's] fresh viewpoint showed me that maybe this doesn't happen everywhere.* (p. 10)

***Students as subject experts.*** In a technology-rich environment, students assume a more prominent role in teaching technology. Researchers found, however, that the teacher role often extended into other, nontechnological areas. At first, this teaching role might happen accidentally:

> *We are covering the Civil War....After we covered some of the battles, a couple of students came up and told me about a Civil War battle that happened around the high school area. I asked them if they would do some research on it and present it to the class....I'm excited because I never knew that....I've had students come up and tell me things before but I have not seen them go out and do research on it. This was from two students in the classroom who are not the best students.* (p. 11)

Eventually, teachers began incorporating into their lesson plans direct opportunities for "student" teaching experiences:

> *I'm getting ready to start my unit from last year when I was away from school and told the kids to figure out how to teach chapter six so they could teach it when I returned. This year I'll be here but I'm trying the same assignment....I'll let them choose what method to use to present.* (p. 11)

Sometimes student-taught lessons required extra time, but the time was perceived to be well-spent:

> *Last week we did our 50's project....I learned some things from students about animation and the Mac IIs. I really enjoyed this project because of the fact that I learned a lot and it really gave the students a chance to show their creativity....We had planned two days for*

> *presentations and it took four days but the quality of the presentations was unbelievable. The presentations together taught the class about the 50's. It made my job a lot easier.* (p. 12).

One set of studies related particularly well to Peakview's situation. Gearheart, Herman, Whittaker, and Novak (1991) evaluate two elementary schools with "high access" to technology. Through structured time-sampled observations, questionnaires, and interviews, they found that technology use at both schools was associated with a unique instructional pattern:

> - Classroom computer uses at both schools were primary applications—word processing, graphics, and HyperCard—rather than instructional software...
> - Students were very likely to be using technology resources when they were working independently or cooperatively...
> - Many teachers were likely to adopt the instructional role of a facilitating, helpful expert (rather than a deliverer of information) when students were engaged in technology-supported work...
> - Students' engagement in challenging work was likely to be supported by technology use... (p. 4)

Gearheart and colleagues characterized this pattern as "constructivist" because it is consistent with a view of students as actively constructing meaning through problem-solving activities (Jonassen, 1991). While they found a consistent pattern associating technology with constructivistic teaching strategies, they found important differences among individual teachers' use of technology. Teachers varied widely (from 15% to 60%) in how often their students used technology. Teachers also varied in the degree of challenge, the degree of cooperative work, and the amount of facilitative (as opposed to directive) activities in the classroom. Gearheart and colleagues offer the following recommendations based upon their findings:

> 1. Construct a model of project support that integrates multiple perspectives.
>     - Create multidisciplinary resource teams.
>     - Help teachers acquire subject matter and curricular expertise.
>     - Help teachers acquire pedagogical expertise.
>     - Adopt support to teachers' needs for particular kinds of expertise at particular times.
> 2. Minimize the fishbowl effect. [The fishbowl effect refers to the special scrutiny teachers undergo when involved in implementing innovations.]
> 3. Involve teachers as collaborators in all aspects of project planning, implementation, and evaluation. (pp. 7–8)

## Computer Planning

Hunter (1985) suggested that computer use in schools often proceeds through three stages:

> Stage 1. Technology—especially computers—is the object of study. New courses, primarily in computer programming or "computer literacy" are established.
>
> Stage 2. ...Computers are viewed as tools which can support the curriculum in a variety of subject areas. Curriculum works is aimed towards integrating

the use of the tools into existing curriculum in mathematics, science, social studies, and language arts.

Stage 3. The focus is less on technology and more on reassessment of curriculum goals and priorities, especially with regard to the relative emphasis on problem solving, information handling, algorithmic thinking, creative communications, and so forth. (p. 3).

Viewed in these stage terms, Peakview's plans for using computers seems to have jump-started to Stage 3; the Peakview plan gives strong emphasis to curriculum redesign and integration, with technology playing an important supportive role within the overall program. The Peakview plan seems to be less stage-oriented and evolutionary, and more committed to serious and integral use of the technology. The extent of their success, of course, is an empirical question to be addressed in the present study.

According to Robert, Carter, Friel, & Miller (1988), four key elements essential to the effective implementation of technology in a school are:

1. support, involvement, and leadership of the principal;
2. teachers educated in the use of computers;
3. an enthusiastic, visionary staff willing to spend the many hours needed to rework the curriculum; and
4. community support, as indicated by the contribution of resources. (p. 10)

Many of these issues are addressed in the present study.

## Teacher Training

Holden (1988) noted the distinctly un-revolutionary character of computer use in the schools over the last decade. She notes, "These many years into the computer age, teachers still have little training in computer use, much less how to choose and employ software productively" (pp. 906–907). Teachers need continuing support and training as they begin using computers in their everyday classroom activities (Carrier & Glenn, 1991). Wiske & Zodhiates (1988) and Fulton (1988) both found that teachers who begin using computers in their teaching report that, initially, computers create *more* work for them. In one survey, time limitation was the most frequent complaint of teachers using computers (Knupfer, 1986).

School officials can sometimes make large hardware purchases, then expect the transition to computer-based learning activities to be simple and straightforward. Surveys of teachers' perceptions, however, stress the importance of needed logistical planning accompanying computer use. The logistical details surrounding computer use should be facilitated by school officials and computer coordinators, reducing the hassles for individual teachers.

Much of the purported reluctance of many teachers to engage in computer-related teaching is their lack of training. As of 1987, only about a third of the teachers in the United States had ten or more hours of computer training (OTA, 1987). Teachers perceive training as the number one issue pertaining to their effective introduction of technologies in the classroom (Lamon, 1987).

Strudler and Gall (1988) have studied the important role of teacher involvement in computer planning: "Teachers expressed being resistant to change when they cannot influence the 'fit' between their curricular responsibilities and the computer program (p. 7). Thus a predicted ingredient of a successful program would be teacher involvement and control over curricular decisions. Computers should not be forced upon teachers as a mandated fix, but rather provided as a learning resource, with room for flexible adaptation to individual teaching and learning styles.

## Technology and School Restructuring

Sheingold (1991) discussed how technology can aid in school restructuring efforts, and offered several recommendations:

1. Bring technology and learning to the same "table" when restructuring is being planned.
2. Reconsider how technology is organized in the district. For example, restructuring schools should consider using resources for:
   - a system to individualize students' schedules and activities
   - a teacher network, with computers on each teacher's desk, to facilitate better communication and planning
   - loaner machines for teachers
   - a multimedia lab with computers, videodiscs, CD-ROM players, and peripherals that enabling students and teachers to create their own presentations and products
   - more classroom machines
3. Work toward a critical mass of equipment and expertise. "If half the teachers in a school are comfortable with using technology in their teaching and do so with some regularity in a variety of curricular areas, there would be a sufficient critical mass of expertise" (p. 26).
4. Use the media to convey new images and metaphors of schooling. (p. 26–27)

Peakview's decision to include technology as part of the restructuring effort is consistent with the recommendations listed above.

## Classrooms Versus Labs

Computer labs are commonly used in schools. There is, however, an observed tendency for hardware to be under-utilized and kept discrete from the day-to-day subject matter. Lab computer use typically doubles when teams of teacher cooperate to set up a computer program within the school (Becker, 1985). Schultz & Higginbotham (1991) summarize the problem of computer placement by suggesting that "the most effective method of placement must be one that allows the classroom teacher free access to integrate computer usage into daily activities" (p. 201; see also Shavelson, Winkler, Stasz, & Robyn, 1983). For elementary schools, that principle would seem to be best implemented by having computers available in individual classrooms.

## Costs and Benefits

In 1989, Adams (1989) reports that schools spent $153 million on software. This is a substantial investment. To place the investment in some kind of perspective, however, Adams maintains that total computer expenditures total only 0.4% of a typical state budget. Education has always been a very labor-intensive activity. By comparison, laboratory, equipment, and materials budgets are relatively small. The primary question concerning computer use in schools has always been one of costs and benefits. Some attention to cost concerns will be given in the present study, although the issue is secondary to establishing the estimated benefits of technology within the school system.

# METHOD

## Evaluation Questions

In consultation with Peakview and Cherry Creek leadership, we developed a list of research questions to be addressed by the study. These questions then drove the development of data-collection instruments, and provided a structure for reporting findings. The list of questions is presented below. They are based on:

- the stated goals and objectives of the school;
- the expressed need of school and district staff;
- the expected impact based on the review of literature.

---

I. What is the impact of the technology on the internal Peakview Elementary School community?
  A. What is the impact of the technology on the students?
    1. What is the impact on the achievement of students?
      a. On students' ability to work effectively in small groups?
      b. On attainment of basic skills?
      c. On students' ability to access and use information?
      d. On students' problem-solving skills?
      e. On students' oral and written communication skills?
      f. On students' ability to research and report on a topic of interest?
      g. Other forms of achievement?
    2. What is the impact on the attitudes of students?
      a. Towards school?
      b. Towards the content areas?
      c. Towards the technology?
      d. Towards learning?
      e. Towards teachers?
      f. Towards themselves?
        - Attitudes of students with low skills towards themselves?
          — Attitudes of students with fine-motor difficulties towards themselves?
        - Attitudes of students with low self-esteem towards themselves?
        - Feelings of empowerment to initiate learning activities and solve their own learning problems?
  B. What is the impact of the technology on the teachers and staff?
    1. In providing tools for curriculum design and development?
    2. What is the impact on classroom processes and activities?
      a. What is the impact on the delivery of instructional presentations?
        - On multimodal presentations (e.g., graphics, audio, motion)
        - On the use of a variety of media (e.g., TV, computer, overhead, chalkboard)
      b. What is the impact on classroom activities?
        - On reaching the full range of student ability?
        - On whole-class versus small-group instruction?
        - On lecture and recitation versus coaching?
        - On competitive versus cooperative social structures?
        - On students' use of both verbal and visual learning media?

- c. What is the breakdown of time allocated to the various uses of technology-related activities (e.g., WP, multimedia and production, basic skills reinforcement)?
- d. What is the impact on task engagement (e.g., time on task) in the classroom?
- e. What is the impact on self-directed learning?
  - On accommodating multiple learning goals in the classroom?
  - On accommodating different learning styles?
  - On students as workers; teachers as facilitators?
  - On students as teachers? (e.g., peer teaching)
  - On student information access and research skills?

3. What is the impact on the work of teachers?
   - a. Workload (number of hours)
   - b. Changes in the kind of work
   - c. Productivity (efficiency)
4. What is the impact on the attitudes of teachers?
   - a. Which technological factors have most affected the attitudes of teachers? For example:
     - Distribution of technology in the school (access)
       —Threshold number of computers in classrooms
       —Computer labs
     - Choice of computer (Mac LC with color)
     - Networking
     - HyperCard-based management and access structure
     - Multimedia computer-based systems
     - Optical laserdisc software
     - Word processing
     - Graphics
   - b. How has the computer coordinator's role and activities affected the attitudes of teachers?
     - Which support functions are most used and valued?
       —computer teacher
       —consultant to teachers on new ways to teach with technology
       —hardware troubleshooting
       —applications expertise
     - How have support needs changed as teachers become more active, proficient users of technology?
   - c. How has the ability to take home a computer affected the attitudes of teachers?
   - d. Does the technology serve a "change agent" role; that is, does the introduction of technology stimulate a reflective and innovative attitude in other content areas?
   - e. Does the technology stimulate a change in teacher perceptions of what students are capable of achieving?
   - f. What is the impact on teachers' willingness innovate and revise teaching methods, to learn new methods and competencies?
     - new technology-related skills?
     - new content teaching methods?
   - g. What is the impact on teachers' self-concepts as competent professionals?
5. What is the relative value of different uses of technology; for example:
   - a. Drill & practice
   - b. Tutorials
   - c. Multimedia presentations

- d. Simulations and toolkits)
- e. Word processing
- f. Graphics
- g. HyperCard stack authoring
- h. Multimedia production

6. What is the impact on other major aspects of reform within the school?
   - a. Management of multi-aging?
   - b. Teaching teams?
   - c. Thematic teaching and interdisciplinary learning?
7. What is the impact on the management and recordkeeping tasks of teachers?
   - a. Class lists?
   - b. Skill lists?
   - c. Assessment records and report cards?
   - d. Learning styles?
   - e. Documenting learning behaviors?
8. What is the impact on the development, use, and management of alternative assessment techniques (i.e., authentic assessments such as portfolios, projects, writing, etc.)?
9. What is the impact in providing communications within the school community?
   - a. Teacher-initiated
   - b. Student-initiated
   - c. External communications
     - Outside parties and databases
     - Teacher, student, and parent access of school file servers

II. What is the impact of the technology on the parents and families of students?
   - A. What is the impact on family knowledge about and practice accessing and using technology?
     1. How many families own or intend to purchase technology?
     2. How many families participate in school-related technology access activities?
        - Technology back-to-school nights
        - School-sponsored training programs
     3. What leadership roles do children play in their families' learning and use of technology?
   - B. What is the impact on family attitudes?
     1. Toward technology?
     2. Toward the schools?
     3. Toward their children?

III. What is the impact of the technology on the external community?
   - A. What kind of press and media coverage is given to technology?
   - B. What kind of support is given to initiatives to support schools and technology with tax dollars?

## Instruments

The lengthy list of evaluation questions suggests that a variety of data-collection methods be used; hence, a number of instruments for data collection were developed and used. These are described below. The instruments are included as Appendix A.

*Baseline survey.* In August 1991, Peakview teachers, staff, and students were surveyed by Karen Peterson, the school's technology coordinator, concerning their use and beliefs about technology. Separate forms were developed for primary (K–2) and intermediate (3–5) grades. Teachers of primary students administered the survey by reading questions to students who needed support. Thus students responded individually to questions; either teachers or aides helped students respond on the survey forms when needed. These surveys were given to the research team upon project initiation.

*Main survey.* Nine months later, in May 1992, Peakview teachers, staff, and students were surveyed again by the research team. Also, three additional elementary schools were selected for comparison; teachers and students at these schools received identical surveys.

- *Primary surveys.* All primary students at the four schools received focused interviews of groups of children. Survey data can be difficult to obtain from young children, but their perspective is valuable. A separate survey designed for administration as a focused group interview was developed for the primary grades (K–2). These interviews were conducted in all primary classrooms at the four schools.
- *Intermediate surveys.* All intermediate students received individual written surveys. All intermediate students in attendance completed surveys on the day of our site visit; all of the site visits were completed within two weeks of each other.
- *Teacher surveys.* All teachers received individual written surveys. Teachers completed the surveys individually and anonymously, and returned them to their respective principals.
- *Staff surveys.* Selected staff at Peakview received the same survey as the teachers. Staff members (librarians, administrators, paraprofessional aides, etc.) at the four comparison schools also completed the survey.

*Teacher/staff interviews.* All 14 full-time teachers at Peakview were individually interviewed in May of 1992. The library director and the principal were also interviewed. The interviews followed a structured interview format, following questions in the interview form included in Appendix B. Some of these interviews were videotaped for later use; notes of all interviews were kept using a Macintosh notebook computer.

*Student interviews.* Twenty-three students were randomly selected from intermediate classes at Peakview in May. These students were interviewed using a computerized structured interview form found in Appendix C. Responses were recorded directly on a Macintosh computer.

*Teacher logs and written reports.* Teachers were asked to keep a regular log of technology-related events occurring in their classrooms. Teachers comments and logs were collected weekly during a two-month period.

*Classroom observations.* The research team made repeated visits to Peakview classrooms, observing student interactions and technology use. Some of these observations were videotaped for future analysis and reporting. Observations made by team members were not systematically analyzed; instead, they helped researchers narrow down anticipated effects. Survey and interview instruments were developed based in part on these insights.

*Performance samples.* As noted above, systematic collection of student performance samples was beyond the scope of the study. The school's first standardized test scores will be unavailable until later this year. Selected samples of student writing and individual research projects were collected. Table 2 summarizes the scope of the data collection effort.

| | Grade Level | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Baseline Surveys—Peakview** | **K** | **1** | **2** | **K-2** | **3** | **4** | **5** | **All** | **NR** | **Total** |
| Grades K-2 Baseline Survey | 16 | 31 | 31 | 78 | | | | | | 78 |
| Grades 3-5 Baseline Survey | | | 2 | | 44 | 49 | 40 | 4 | | 138 |
| Staff Baseline Survey | | 9 | | | | 6 | | 9 | 1 | 25 |

| Main Surveys—All Schools | Dry Creek | Peakview | Polton | Summit | Total |
|---|---|---|---|---|---|
| K-2 Main Focus Interview | 5 | 11 | 4 | 5 | 25 |
| 3-5 Main Survey | 142 | 119 | 145 | 119 | 525 |
| Staff Main Survey | 13 | 23 | 18 | 25 | 79 |

| | Grade | | | | | |
|---|---|---|---|---|---|---|
| **Main Surveys - Peakview** | **K-2** | **3** | **4** | **5** | **NR** | **Total** |
| K-2 Main Focus Interview | 390 | | | | | |
| 3-5 Main Survey | | 186 | 134 | 190 | 15 | 525 |

| Interviews - Peakview | Total |
|---|---|
| Grades 3-5 Student Interviews | 23 |
| Staff Interviews | 15 |

| Other data—Peakview | Gender | | | | |
|---|---|---|---|---|---|
| **Instrument** | **M** | **F** | **Teacher** | **Teaching Assistant** | **Other Staff** |
| K-2 Baseline Survey | 34 | 44 | | | |
| 3-5 Baseline Survey | 80 | 57 | | | |
| Staff Baseline Survey | 5 | 20 | | | |
| K-2 Main Focus Interview | 194 | 196 | | | |
| 3-5 Main Survey | 270 | 240 | | | |
| Staff Main Survey | 12 | 66 | 60 | 7 | 12 |
| Teacher Logs | 5 | 9 | | | |

Table 2. *Profiles of response samples to surveys and other data collection instruments.*

## Data Collection Procedures

Copies of the teacher/staff main surveys were distributed to the four comparison schools; teachers were asked to complete the form and return it to their principal or the UCD research team.

Grade K–2 main surveys were administered in the following way: Two researchers entered a classroom at a designated time. The teacher introduced the researchers and left the room. The two researchers then divided the class into two groups and conducted a group interview with each group, proceeding through questions on the form. The researchers indicated the direction and distribution of students' responses on the form. When both researchers had completed their group interviews, the teacher was invited back into the classroom and the researchers left the room.

Main surveys for intermediate (grades 3–5) students were administered in the following way: Two researchers entered a classroom at a designated time. After introducing the researchers and the purpose of the survey, the teacher left the classroom. The researchers distributed copies of the survey to each student and read aloud the questions, answering any questions and clarifying meaning when needed. Students privately and individually responded to the questions on the survey by writing down answers. Extra help was given to students who had difficulty reading the questions or interpreting their meaning. When all students had completed the survey, the teacher was invited back into the room and the researchers left.

## Data Analysis

Analysis of the data entailed two stages: response encoding and data interpretation.

*Response encoding*. Individual survey responses were encoded into Macintosh *Excel 4.0* files. Open-ended questions were included verbatim in these files. Responses were spot-checked for accuracy, particularly for anomalous findings.

Researchers recorded responses to Peakview interview questions directly on Macintosh notebook computers. These files recorded during the interviews were edited by researchers within two days for spelling and grammatical errors, as well as for clarity of meaning.

Weekly log forms were encoded into *Microsoft Excel* files.

The data files used in the study are attached in Appendix D of the full report in order to facilitate future research.

*Data interpretation*. Depending on the data source, a number of different strategies for interpreting the data were used. For surveys, bar charts were developed to display the means and distributions of responses to questions; responses were separated according to school, with Peakview separated from the remaining schools to allow clear comparisons. These bar charts allow a visual comparison of the response patterns between Peakview and the comparison schools. Line charts were also developed comparing the mean responses of the four schools. Where possible, chi square ($\chi^2$) or analysis of variance (F statistic) were calculated to compare responses across schools.

Responses to open-ended questions from the survey and interview questions were treated similarly. Data were coded into qualitative categories; these categories were then used for reference and retrieval. In addition, where appropriate counts were conducted on the frequency of different response categories; the frequency breakdowns of these counts are presented in the findings.

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# EXPANDED FINDINGS

The Findings section is organized according to the research questions presented in the introduction; specifically, we present the findings in the following order:

**Use of Technology**

**Impact on Teaching**

**Implementation Factors**

**Teacher Attitudes**

**Student Achievement**

**Student Attitudes**

The presentation of results follows a standard format throughout the report, depending on the type of data relevant to the question. Graphical representations of means across the four schools is included to provide a context; however, because the focus is on Peakview, only occasional comment is made regarding other schools specifically. Where possible the narrative is structured as follows:

1. Evaluation of Peakview quantitative data (survey response frequencies, etc.);
2. Comparison with other schools when discussion is warranted;
3. Graphical representation of quantitative data for Peakview and other schools;
4. Qualitative analysis of Peakview interviews, open-ended questions, and observations;
5. Presentation of illustrative quotes;
6. Conclusions and recommendations.

Groups in the school will be discussed in the following order:

1. Teachers;
2. Intermediate Grades (3-5);
3. Primary Grades (K-2).

## Notes on Reporting Style

Throughout the report, we discuss the impact of technology within the schools. However, there is nothing magic about technology in and of itself. Rather, we are interested in ***the way technology is used***. How is technology used at Peakview Elementary, and how does that way of using technology affect students and teachers? This emphasis should be remembered throughout the various sections of the report. However, for brevity of expression, we often use language such as "the technology impacted" or "technology resulted in such and such." Such language should be taken as shorthand for "the way technology was used resulted in such and such."

To protect the confidentiality of teachers, fictitious names are used. Real first names of students are used. Where no attribution is given, a quote comes from open-ended responses to Main Survey questions.

The best way to read the survey data is to inspect the graphs contained in the figures. To facilitate comparison between Peakview and non-Peakview respondents, we have placed three graphs together into a single figure:

1. A summary graph of the four school means. The line graphs comparing across schools are all designed with "up" being positive and "down" being negative.

2. A frequency table showing the distribution of responses from Peakview teachers or students.

3. A similar frequency table for non-Peakview respondents.

Thus at a glance, differences between groups should be detectable.

Within each school, the large majority of teachers participated in the surveys, with response rates ranging from 90 to 100%. Thus, to make the Findings section more readable, we drop mention of "sampled respondents." Please note, however, that our findings do indeed constitute a sample and may not fully represent the thinking of the faculty in different settings or timeframes.

Finally, the Main Survey was administered to all staff members at the school, including classroom teachers, special education teachers, library/media personnel, and administrators. However, because all of these personnel can be considered teachers in the broad sense, and because classroom teachers constituted at least 85% of the respondents, we refer to the sampled group generically as "teachers." While we recognize differences among the sampled groups, we have pooled the responses of all school personnel into our comparison figures. Specific comparisons of different groups is possible, and could be completed at a later date.

## Use of Technology

How much time do students work with technology at school, doing what kinds of activities? What aspects or features of the technology are being used? These questions of usage are addressed in this section.

### Prior Experience

Peakview teachers were selected before the technology orientation of the school became clear. Thus it is not surprising that teachers report a full range of prior experience at the beginning of the school year (Figures 1 and 2). Teachers report a very wide spectrum of background with computers, both in the classroom and more generally. In this sense, the reaction of Peakview teachers to the technology can be seen as fairly representative of other elementary teachers within the district.

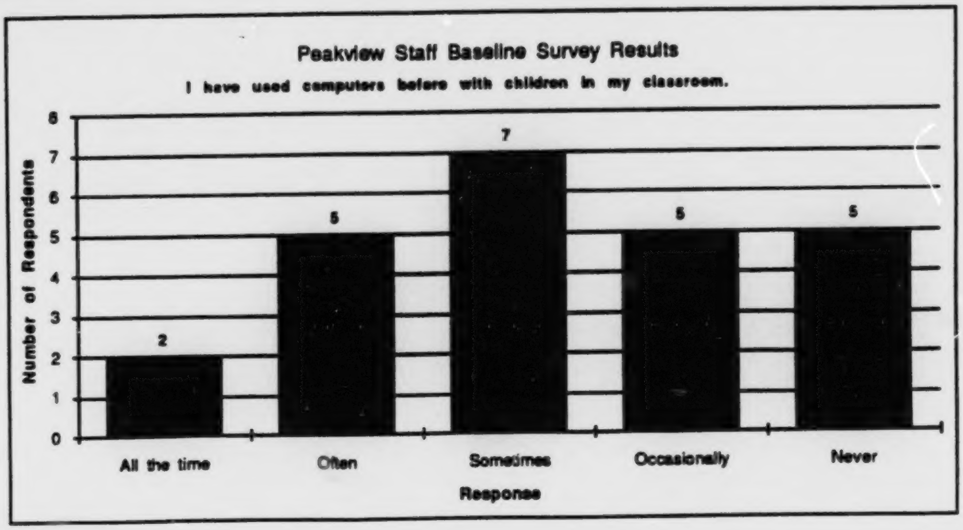


Figure 1.

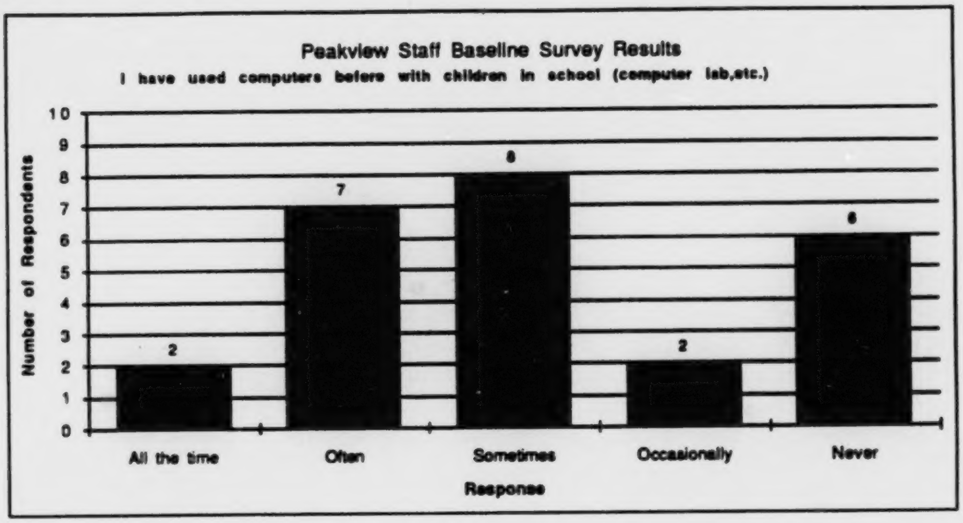


Figure 2.

Some teachers commented on their prior experiences with technology before coming to Peakview; for example:

> *My past experience was with the Apple IIe's... one computer in the classroom... glorified worksheet disks. So it was just used as a fun center where kids would play games, and I didn't see any learning value in it at all because I'm not a worksheet type of teacher.* Jennifer, primary teacher

> *What I've seen is that technology has grown from Apple IIe's. We've come so far. The whole concept has broadened so much--laserdiscs, scanners, printers, video equipment, etc. It's hard to keep up with it, and I'm trying to grow along with it.* Patricia, media specialist

In the fall, two teachers compared prior conceptions to their present situation:

> *[I used to] ...only do word processing and games.*
> *[Now I] ...use many programs for many reasons.*
>
> *[I used to]...believe that computers were fancy games.*
> *[Now I]'ve ...seen the powerful tool for learning and for showing mastery that computers and technology can be!*
>
> *[I used to] ...not have a clue as to how to help my students who needed help with work on the computers.*
> *[Now I] ...understand, utilize, and can speak the same language as my students regarded computers.*

## Time on Technology

> *The amount of time that kids are on the computers is much more significant this year. I have high expectations for using computers because of our investment.*
> Brad, Kindergarten teacher

The statement above epitomizes the feeling of many staff members at Peakview. Several measures indicate that Peakview students spend more time with technology. Figures 3 and 4 indicate that, based on teacher reports, a typical Peakview student spends roughly twice the time on technology as a student in a comparison school (F=7.74, p<.01). While the proportion of time is probably reliable, the literal totals taken from the staff survey conflict with Peakview teachers' weekly logs (Figure 4). Over the seven-week sampling period in the spring of 1992, the average percent of the day spent on technology-related activities at Peakview was 39%, according to weekly teacher logs for this period. This adds up to more than the 3 hours per week reported in the staff survey. Given this inconsistency, the precise number of hours spent using technology is uncertain, but it is clear that Peakview students have considerably greater access to technology than their counterparts in the comparison schools.

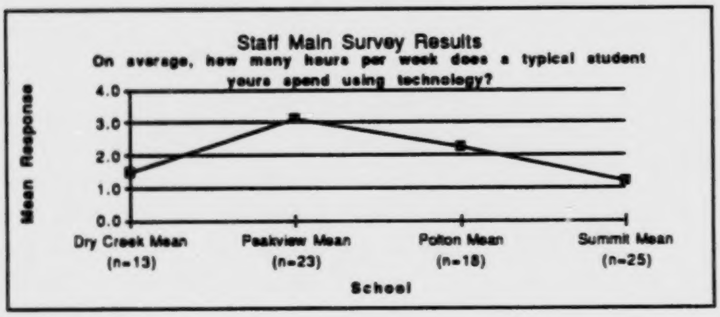


Figure 3.

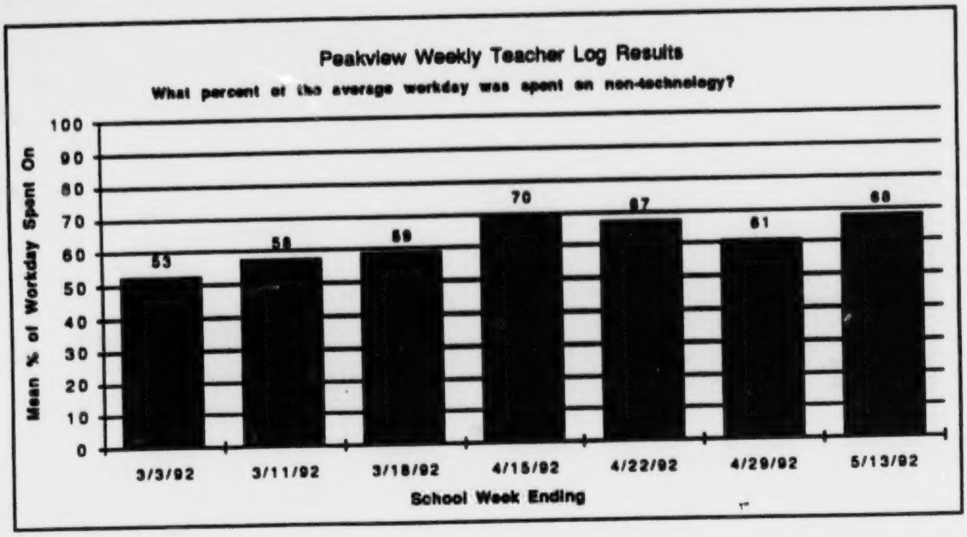
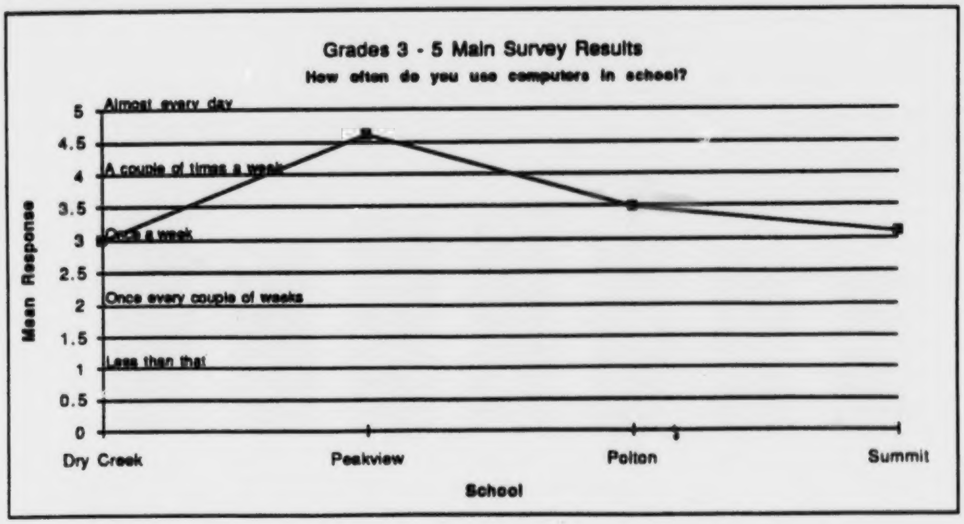
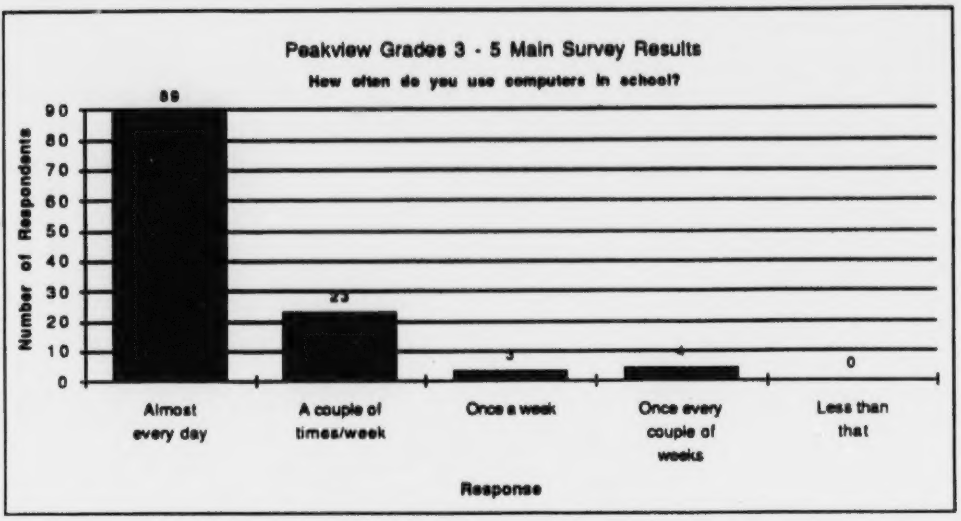


Figure 4.

Students confirm the 2-to-1 difference in access between Peakview and the other schools. In Figure 5 Peakview intermediate students report using computers several times a week, whereas students at comparison schools average about once or twice a week ($\chi^2$=153.13, p<.001). Figure 6 presents the similar report of primary students.





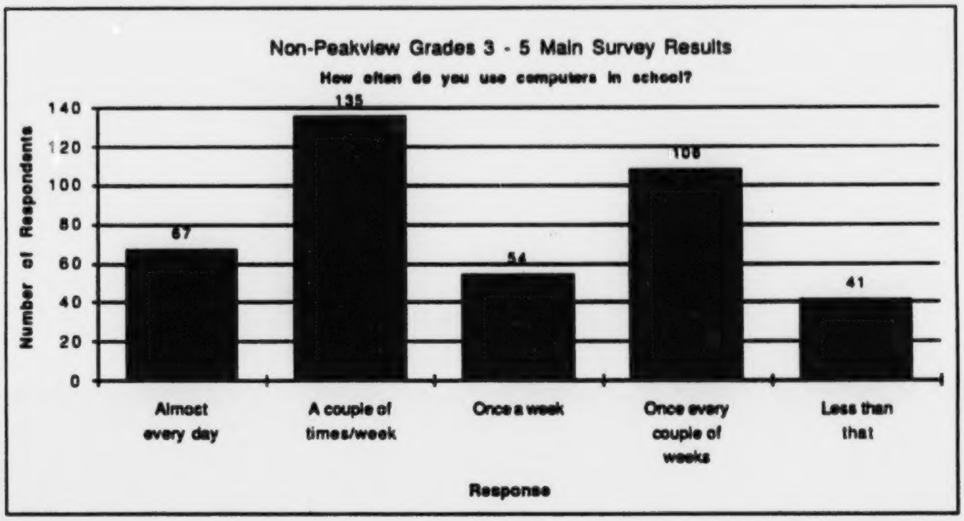


Figure 5.

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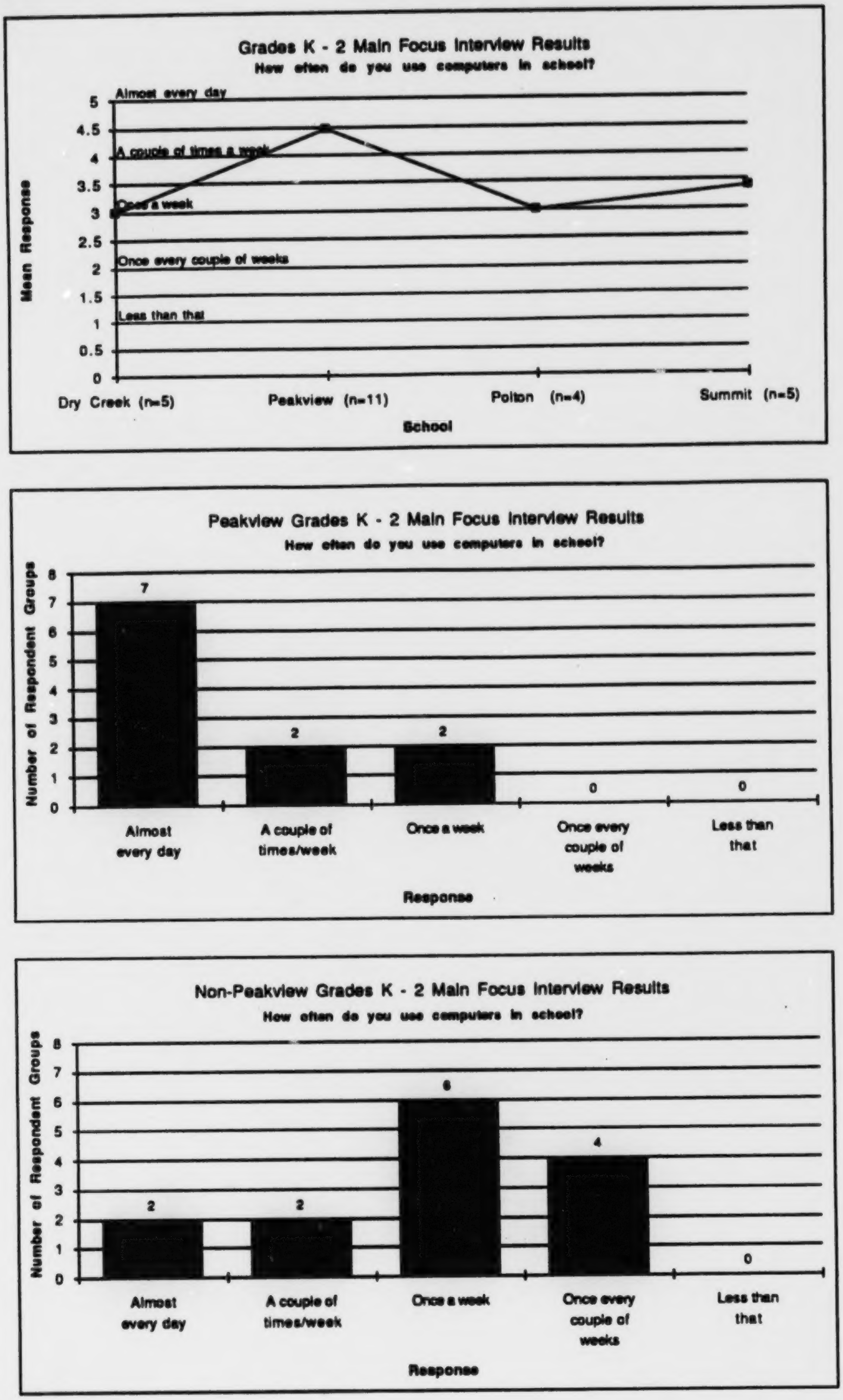

Grades K - 2 Main Focus Interview Results
How often do you use computers in school?
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Almost every day
A couple of times a week
Once a week
Once every couple of weeks
Less than that
Dry Creek (n=5)
Peakview (n=11)
Polton (n=4)
Summit (n=5)
School
Peakview Grades K - 2 Main Focus Interview Results
How often do you use computers in school?
Number of Respondent Groups
8
7
6
5
4
3
2
1
0
7
2
2
0
0
Almost every day
A couple of times/week
Once a week
Once every couple of weeks
Less than that
Response
Non-Peakview Grades K - 2 Main Focus Interview Results
How often do you use computers in school?
Number of Respondent Groups
8
7
6
5
4
3
2
1
0
2
2
6
4
0
Almost every day
A couple of times/week
Once a week
Once every couple of weeks
Less than that
Response

Figure 6.

## Technology-Related Activities

What kinds of activities do students engage in while using technology? The following table summarizes responses to questions on the Main Survey that asked teachers to estimate the amount of time (several times a day, most days, some days, or rarely) students engage in word processing, database, spreadsheet, art/graphics, authoring, and other activities. The largest differences between Peakview and the comparison schools were in the amount of time students were engaged in word processing, art/graphics, and in viewing laserdiscs. Peakview teachers also reported a greater proportion of instructional software activities. The category "% of Peakview Day" is taken from teachers' weekly logs.

| Activity | % of Peakview Day[1] | Peakview Modal Response | Non-Peakview Modal Response | p≤ |
|---|---|---|---|---|
| Word Processing | 19 | Most Days | Some Days | .001 |
| Authoring | 17 | Somedays | Rarely | .06 |
| Art/Graphics | 12 | Most Days | Some Days | .001 |
| Instructional S/W | 11 | Most Days | Some Days | .01 |
| Laserdisc Viewing | 8 | Some Days | Rarely | .001 |
| Database | 1 | Rarely | Rarely | ns |
| Spreadsheet | 1 | Rarely | Rarely | ns |
| LOGO | — | Rarely | Rarely | ns |

Table 3. *Teacher reported time allocated to various technology activities.*

The following table presents student reports of technology use that corroborates the teacher data.

---

[1] Based on the weekly teacher logs.

| Technology-Related Activity | Peakview Student Use | Non-Peakview Student Use | Chi Square | p≤ |
|---|---|---|---|---|
| —Intermediate Students— | | | | |
| To learn new things | A lot | Some | 26.84 | .001 |
| To make art | A lot | A little | 75.72 | .001 |
| To write stories or reports | A lot | Some | 36.64 | .001 |
| To find new information | A lot | Some | 21.44 | .001 |
| To play games | Some | Some/A little | ns | ns |
| To practice things you already know | Some | Some | ns | ns |
| To listen to music | Not at all | Not at all | ns | ns |
| —Primary Students— | | | | |
| To learn new things | A lot | Some | ns | ns |
| To make art | A lot | A little | n/a | n/a |
| To write stories or reports | A lot | A lot | n/a | n/a |
| To find new information | Some | Some/A little | n/a | n/a |
| To play games | A lot | A lot | ns | ns |
| To practice things you already know | A lot | Some | ns | ns |
| To listen to music | A little | Not at all | n/a | n/a |

Table 4. *Student reports of technology-related activities.*

Note the differences between Peakview and non-Peakview responses. Peakview students report using technology more for finding information, for writing reports and stories, for making art, and for learning new things.

One interesting difference exists between intermediate and primary students: intermediate students report playing fewer games than primary students. This seems to confirm our classroom observations that older grades seem to broaden their uses of technology and increase their writing, research, and production activities.

In a fall self-report, one teacher described the increased use of technology:

> *[I used to] ... make banners and one or two form sheets on the computer.*
>
> *[Now I] ... utilize the computer in all aspects. We start each day with a note from the teacher, use the computers integrating them with math measurement, writing, and HyperCard. I'm also using it for most all of my recordkeeping.*

*HyperCard* is a Macintosh program for authoring lessons, projects, and presentations. It combines elements of database, graphics, and scripting into an authoring environment. Although use of *HyperCard* at the comparison schools was minimal, Peakview teachers and students reported extensive use of and enthusiasm for the program. Some comments from Peakview teachers regarding *HyperCard* follow:

> *Despite my initial questions, HyperCard has proven to be a great software environment for even our young ones. The production opportunities that we afford our kids to demonstrate their learning with the help of technology are priceless!* Jim, administrator
>
> *...HyperCard software stands as a viable solution for schools seeking to expand their collective vision of what schools should be about.* Adam, intermediate teacher
>
> *The value of cooperative learning, reading and writing has become more apparent. Groups of students, sometimes of like ages and sometimes different, come together to create a HyperCard stack, a variation of the Cinderella tale, or a cooperative game such as Wagon Train. The natural leadership which exists in every classroom emerges, as students who are good editors are called forth to look at a piece on the computer, or a student who knows HyperCard is asked a question about buttons or scripts.* Adam, intermediate teacher
>
> *Focusing on the Macintosh HyperCard, this class thoroughly explored the technical aspects of assembling a 'HyperCard stack'. The complexity of HyperCard is probably what makes it such an exciting and useful classroom tool.* Vicky
>
> *I've been taking the latest class from Kate...HyperCard stacks. I can see a lot of value in that in terms of student-led conferencing. HyperCard stacks can help students conduct conferences with their parents.* Jennifer, primary teacher
>
> *...but now when I see HyperCard stacks, and kids' projects...endless possibilities for creativity within HyperCard stacks. It's almost like redefining creativity, or seeing a new way to be creative, that I did not know about before.* Patricia, media specialist

Laserdiscs and other technologies were also well-received by teachers:

> *It's not uncommon, if the kids are researching a topic, to say, May I go to the media center to get this resource, to watch this laserdisc, etc. This is much different than the way it was in the past.* Michael, intermediate teacher

> *[I'd like to] incorporate Laserdiscs more in the classroom.* Sandy, primary teacher

> *Kids seeing themselves as information seekers and users...using laserdiscs, GTV, Visual Almanac...turning around and creating products.* Adam, intermediate teacher

> *It was a hook to have them write. Even higher-end [ability] kids like technology enhancements, including bar codes, laserdisc, HyperCard, CD-ROM, etc.* Elizabeth, intermediate teacher

> *They are much more motivated by such avenues as computers and laser disks to read and write.* Gail

A student further endorses laserdiscs:

> *When I first came I had never heard the word laser disc. I will tell you what laser disc means — Very fun, educational and fantastic.* Anne

A number of Peakview teachers addressed the effects of increased student access to the technology:

> *The amount of time that kids are on the computers is much more significant this year. I have high expectations for using computers because of our investment.* Brad, Kindergarten teacher

> *The students used them [computers] for word processing and keyboarding skills daily. The computers became personal learning tools that helped kids of all abilities.* Michael, intermediate teacher

> *There are certain times, free times, where kids can do anything they want. They can come before school, stay in at recess, etc.* Elizabeth, intermediate teacher

> *First thing is having computers in the classroom. If I would have been coming through visiting, that's the first thing that stands out in my mind. In-classroom [computers are] better than a lab situation. My kids would not feel [the same] about computers if they went out to a lab once a week. Time allotted...daily. Maybe three days since the beginning of the year they have not had access to computers... scheduled and unscheduled time on the computer.* Nora, Kindergarten teacher

In summary, Peakview's access and exploitation of technology is unsurprisingly greater than that of the three comparison schools. A mean of nearly 40% of Peakview's classroom activities was characterized as engagement in technology-related instructional activity according to weekly teacher logs.

## Use of Media

The Main Survey asked teachers to report their media usage in the classroom. Specific media addressed include: computer screen, television and video, overhead projector, chalkboard, textbook, print handouts, worksheets, and library books. For the sake of brevity, Table 5 summarizes the data reported for Peakview staff members and for staff responses in all four schools:

| Media | Modal Response at Peakview | Four Schools Compared | Chi-sqd | p< |
|---|---|---|---|---|
| Computer screen | 13 of 24 'somedays' | Peakview higher | 13.66 | .01 |
| TV or video | 18 of 20 'somedays' | similar | — | ns |
| Overhead projector | 14 of 20 'somedays' | similar | ns | ns |
| Chalkboard | 8 of 20 'most days' | similar | 7.19 | ns |
| Textbook | 19 of 20 'rarely' | Peakview lower | 18.29 | .001 |
| Handouts | 13 of 20 'somedays' | Peakview lower | ns | .01 |
| Worksheets | 11 of 20 'somedays' | Peakview lower | ns | .01 |
| Library Books | 12 of 20 'several times a day' | similar | ns | ns |

Table 5. *Teacher reported media usage in the classroom.*

Note the greater usage of computer media and the lesser use of textbooks at Peakview compared to the other schools. This is to be expected, since Peakview purchased computer software instead of textbooks. Peakview teachers also report using fewer printed handouts and worksheets.

## Use of Hardware

Recall that from 3 March to 13 May 1992, Peakview teachers kept logs of their classroom use of various technologies. For part of their logs, they were asked to classify their use of various hardware devices into categories of use: 'Heavy', 'Medium', 'Light', and 'No Use.' While these categories do not reflect specific numbers of hours, they do provide a relative basis for comparing across different hardware devices. Table 6 summarizes teachers' reports. Items are presented in order of frequency of reported use; grouped items represent similar responses. Full graphs are included in Appendix D.

| Hardware Device | Reported Use |
|---|---|
| Macintosh computer | Medium use |
| Books and hard-copy materials | Medium use |
| Printer | Light use |
| Chalkboard | Light use |
| Laserdisc player | Light use |
| Overhead projector | Very light use |
| Video cameras and production | Very light use |
| CD-ROM | Very light use |
| VCR | Very light use |
| Notebook computers | Very light use |
| PC Viewer | Very light use |
| Bar code reader | Very light use |
| Scanner | No reported use |
| Canon Zapshot | No reported use |

Table 6. *Reported use of hardware devices from Peakview teachers' weekly logs.*

Students confirm this pattern of hardware use. Table 7 below summarizes student responses to the main survey concerning use of computer, laserdisc players, and VCRs or zapshot cameras.

| Technology | Peakview Mean Response | Non-Peakview Mean Response | Chi Square | p≤ |
|---|---|---|---|---|
| —Intermediate Students— | | | | |
| Computer | Almost every day | Once a week | 153.13 | .001 |
| Laserdisc player | Once or twice a week | Haven't this year | 225.53 | .001 |
| Camcorder/zapshot | One or two times only | Once or never | 30.27 | .001 |
| —Primary Students— | | | | |
| Computer | Almost every day | Once a week | ns | |
| Laserdisc player | Once every week or two | Haven't this year | ns | |
| Camcorder/zapshot | One or two times only | Never | 7.90 | .05 |

Table 7. *Student reports of frequency of hardware use.*

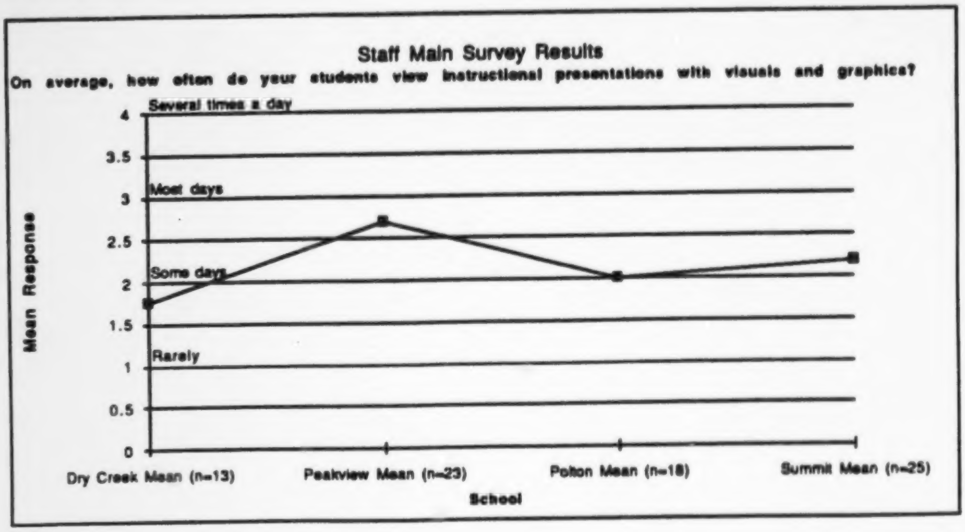
During interviews, Peakview teachers commented on the increased use of technology:

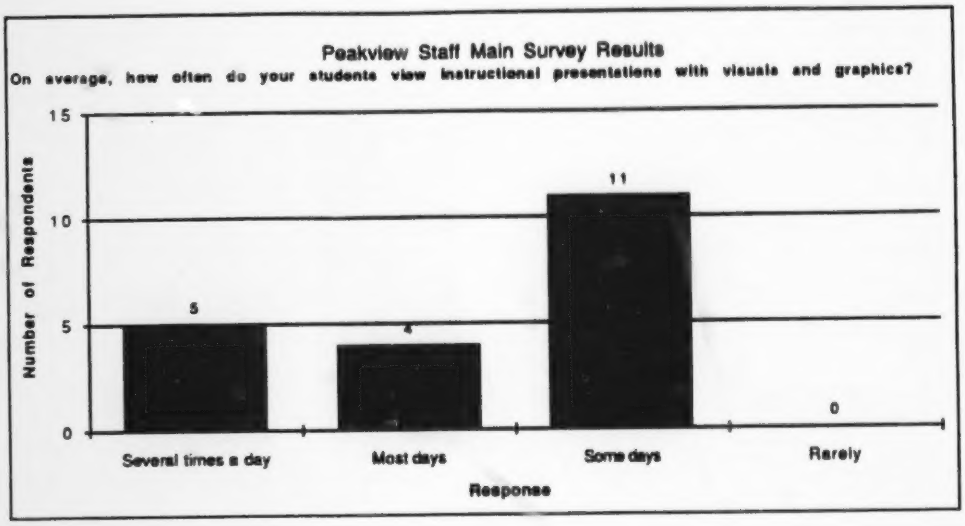
> *The amount of time that kids are on the computers is much more significant this year. I have high expectations for using computers because of our investment.* Brad, Kindergarten teacher

> *It is always part of every day. It is interesting...depending on the themes we're doing. The students used the scanners to find or create pictures for the Africa unit. The computers are part of every subject.* Charlotte, primary teacher

## Use of Multiple Modalities

Nine of 20 or 45% of the Peakview teachers indicated that their students view instructional presentations with visuals or graphics several times a day or on most days, with 11 staff members responding with 'some days' (see Figure 7 on the following page). This mode of presentation is used significantly more at Peakview than at the comparison schools ($\chi^2=16.02$, $p<.01$). Figure 8 indicates that presentation of instruction with a purely audio mode is not used as often as the visual/graphic mode. Audio (not including teacher lecture) is used 'sometimes' by 70% of the Peakview teachers, which is comparable to the other schools in the study. Use of motion and animation modes are similar to audio. Figure 9 indicates that 60% of the Peakview teachers use motion and animation for their presentations, significantly more than non-Peakview teachers ($\chi^2=7.88$, $p<.05$).


Staff Main Survey Results
On average, how often do your students view instructional presentations with visuals and graphics?
Several times a day
Most days
Some days
Rarely
4
3.5
3
2.5
2
1.5
1
0.5
0
Mean Response
Dry Creek Mean (n=13)
Peakview Mean (n=23)
Polton Mean (n=18)
Summit Mean (n=25)
School


Peakview Staff Main Survey Results
On average, how often do your students view instructional presentations with visuals and graphics?
15
10
5
0
Number of Respondents
5
4
11
0
Several times a day
Most days
Some days
Rarely
Response

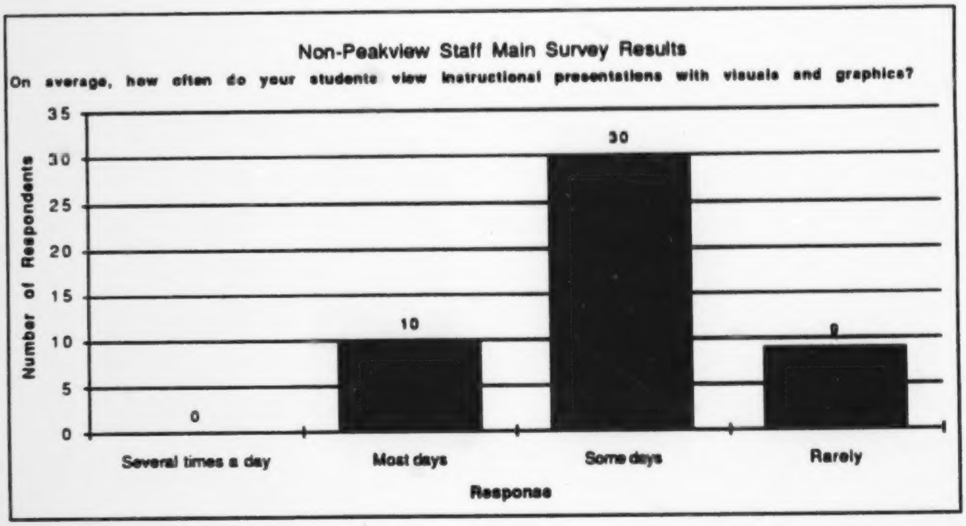

Non-Peakview Staff Main Survey Results
On average, how often do your students view instructional presentations with visuals and graphics?
35
30
25
20
15
10
5
0
Number of Respondents
0
10
30
9
Several times a day
Most days
Some days
Rarely
Response

Figure 7.

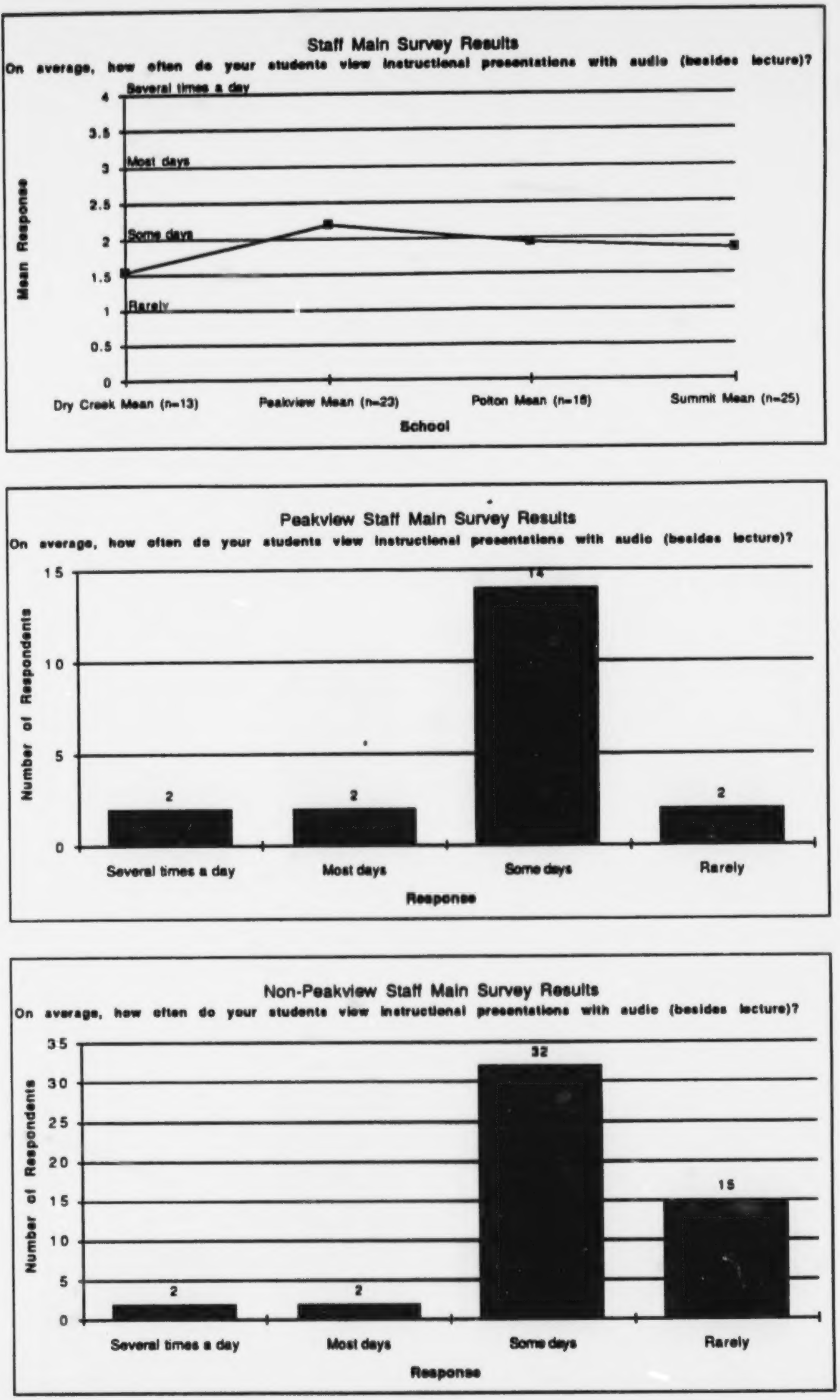

Staff Main Survey Results
On average, how often do your students view instructional presentations with audio (besides lecture)?
Several times a day
Most days
Some days
Rarely
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek Mean (n=13)
Peakview Mean (n=23)
Polton Mean (n=18)
Summit Mean (n=25)
School
Peakview Staff Main Survey Results
On average, how often do your students view instructional presentations with audio (besides lecture)?
Number of Respondents
15
10
5
0
2
2
14
2
Several times a day
Most days
Some days
Rarely
Response
Non-Peakview Staff Main Survey Results
On average, how often do your students view instructional presentations with audio (besides lecture)?
Number of Respondents
35
30
25
20
15
10
5
0
2
2
32
15
Several times a day
Most days
Some days
Rarely
Response

Figure 8.

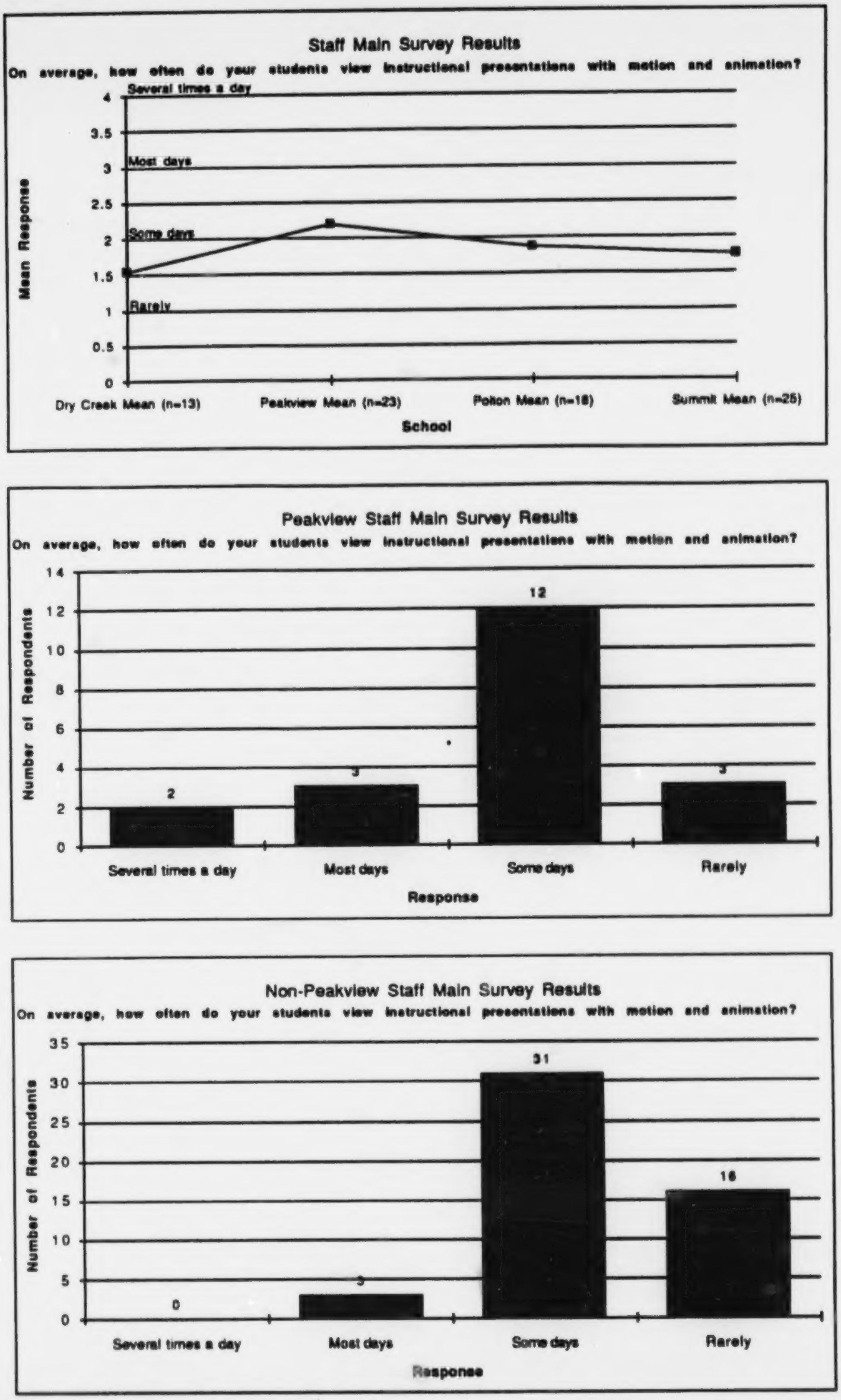

Staff Main Survey Results
On average, how often do your students view instructional presentations with motion and animation?
Several times a day
Most days
Some days
Rarely
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek Mean (n=13)
Peakview Mean (n=23)
Polton Mean (n=18)
Summit Mean (n=25)
School
Peakview Staff Main Survey Results
On average, how often do your students view instructional presentations with motion and animation?
Number of Respondents
14
12
10
8
6
4
2
0
2
3
12
3
Several times a day
Most days
Some days
Rarely
Response
Non-Peakview Staff Main Survey Results
On average, how often do your students view instructional presentations with motion and animation?
Number of Respondents
35
30
25
20
15
10
5
0
0
3
31
16
Several times a day
Most days
Some days
Rarely
Response

Figure 9.

In general, the data on media use suggest a move away from texts, chalkboards, hardcopy materials and worksheets at Peakview. While some technologies are used consistently, other technologies available at the school seem to be used lightly.

## Verbal and Visual Learning Media

Teachers at the four schools report using slightly more verbal media than visual media in the classroom (Figure 10). The difference between Peakview teachers and other teachers, while in the direction of visual media, is not statistically significant. Peakview teachers indicated that technology affects their use of visual media more than non-Peakview teachers (Figure 11; $\chi^2=6.47$, $p<.05$).

One teacher commented how the overhead projection panel helps in the classroom:

> *Imagination comes alive. With the PC viewer, anonymous student work or examples of work that I might generate can be put up on the board for editing demonstrations.* Michael, intermediate teacher

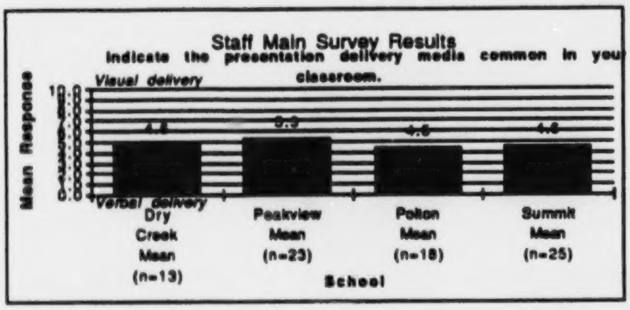


Figure 10.

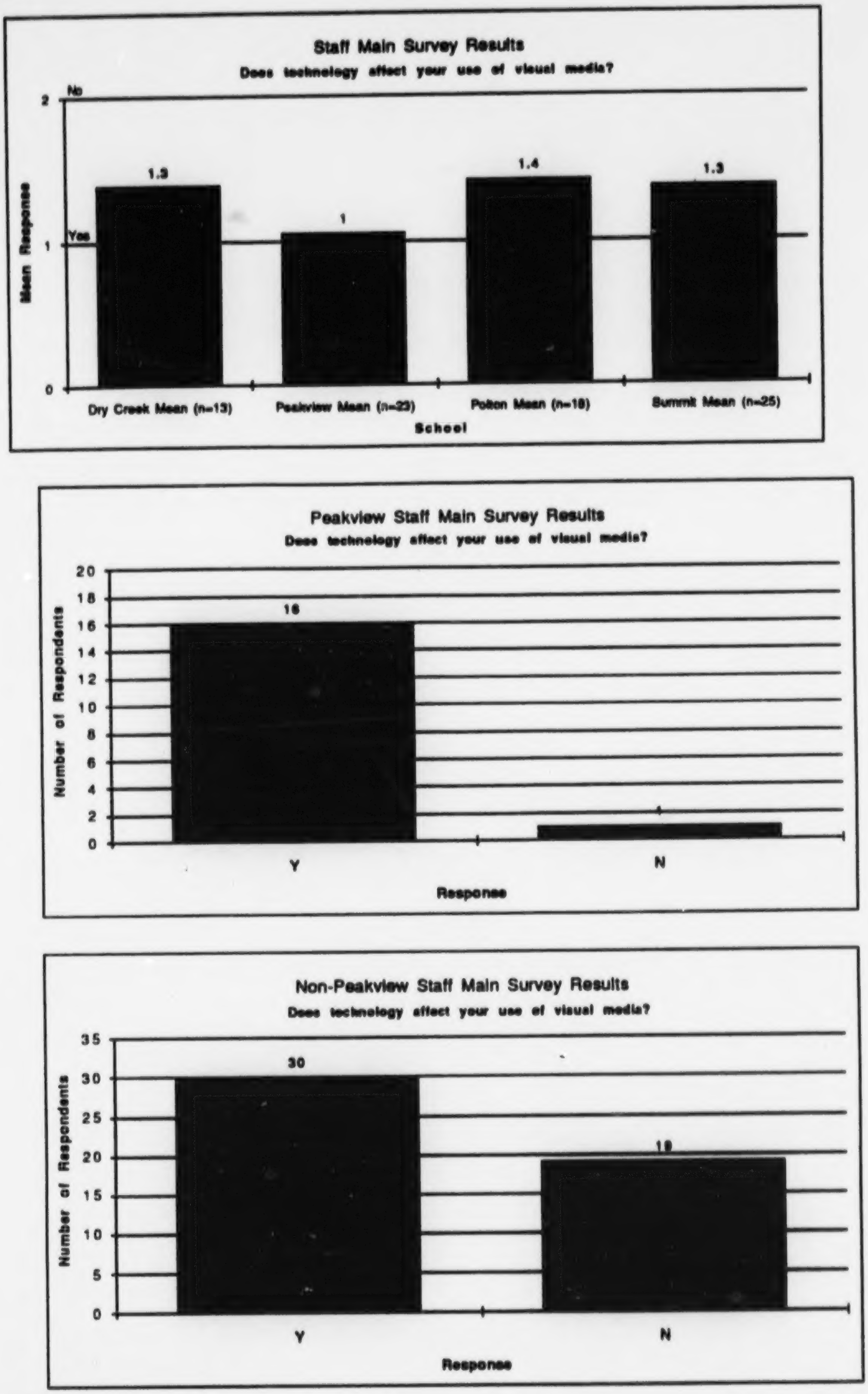

Staff Main Survey Results
Does technology affect your use of visual media?
Mean Response
2
1
0
No
Yes
1.3
1
1.4
1.3
Dry Creek Mean (n=13)
Peakview Mean (n=23)
Polton Mean (n=18)
Summit Mean (n=25)
School
Peakview Staff Main Survey Results
Does technology affect your use of visual media?
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
16
Y
N
Response
Non-Peakview Staff Main Survey Results
Does technology affect your use of visual media?
Number of Respondents
35
30
25
20
15
10
5
0
30
19
Y
N
Response

Figure 11.

## Strategies for Equitable Access

Achieving equitable access to technology among different kinds of learners is a concern for many educators. Teachers comment on the problem:

> *One problem is with management...with getting kids to the computers. I had to rethink how to get them the time they need—quality time on the computers.* Main Survey

> *Tom and I have tried to stagger so that one of us maximizes the full use of computers, then be flexible enough for his kids...sharing and maximizing between the two teachers. Right now we're doing reports on endangered species. The kids are to include one piece of technology as part of their oral report.* Elizabeth, intermediate teacher

To address this concern, teachers were asked a number of questions regarding how their students were granted time on the computers, and teachers' purposes in granting that time. The following table summarizes the findings.

| How often are your students given access: | Peakview Teachers Modal Response | Non-Peakview Teachers Modal Response | Chi Square | p≤ |
|---|---|---|---|---|
| As a reward for good performance or behavior | Never | Sometimes | ns | ns |
| For finishing their assigned work early | Sometimes | Sometimes | ns | ns |
| As an information resource for reports and other projects | Often | Sometimes | 12.63 | .01 |
| For enrichment beyond the core curriculum | Often | Often | ns | ns |
| For remedial practice at basic skills | Sometimes | Sometimes | ns | ns |
| As part of a normal assignment | Often | Sometimes | ns | ns |

Table 8. *Teacher strategies for granting access to technology.*

Only one statistically significant difference was found, on granting students access for use as an information source for reports and projects. This may reflect Peakview's use of electronic encyclopedias and other CD-ROMs and optical laserdiscs. Peakview teachers also report very rarely using access to technology as a reward for good behavior.

# Impact on Teaching

What impact does the technology have on teachers' everyday routine? Does it change the way teachers teach? The way they relate to their students? This section addresses these questions.

## Changes in Teacher Work

Computers are often promoted as productivity tools that can save teachers time. While computers typically result in greater output, they do not necessarily result in a reduction of time on the job. Also, learning to use computers effectively takes time, a precious commodity for busy schools. We asked teachers whether the use of technology constituted a net addition or reduction in the amount of time they spent at their work. Figure 12 shows clearly that teachers generally report technology resulting in an increase of time on the job. Peakview teachers reported an increase in time by a proportion of 14 to 3.

There is a sense, however, in which a teacher's time can be freed up by the technology. There is often less burden on the teacher to be responsible for instructional presentation. One teacher observed a feeling of greater flexibility resulting from access to technology:

> *My time is freed up considerably through technology. I have time to sit down with kids and give them individual or small group time.* Michael, intermediate teacher

Computers can also give teachers a greater sense of control over their work:

> *[It's] just a different tool I'm using. In other ways I feel like I'm being more professional. I used to hand-write all the notes to parents, quizzes, etc.—now I word process them. The looks of what I produce are nicer...makes me [look] prepared and more professional than I really am.* Lynn, primary teacher

In the fall, teachers expressed their new-found confidence in taking control of the computer:

> *[I used to] ... write and hand it to a T.A.*
> *[Now I]... use the computer!*
>
> *[I used to] ... think computers took too much time to implement.*
> *[Now I]... have it on the entire day.*
>
> *[I used to] ... think that the only application for computers in the psychology field was for writing reports with commercial programs.*
> *[Now I] ... am beginning to try to think of new ways that the computers can be a time-saver for me.*
>
> *[I used to]... be afraid of word processing/graphics*
> *[Now I] ... use Microsoft Works, HyperCard and The Writing Center.*

Whatever the advantages of using technology, it seems that "saved time" is not one of them. It would thus be unfair to promote the use of technology using such arguments to other teachers. On the other hand, an administrator may well welcome teachers' willingness to spend extra time on the job in order to secure valued ends. In other words, they work harder and like it more.

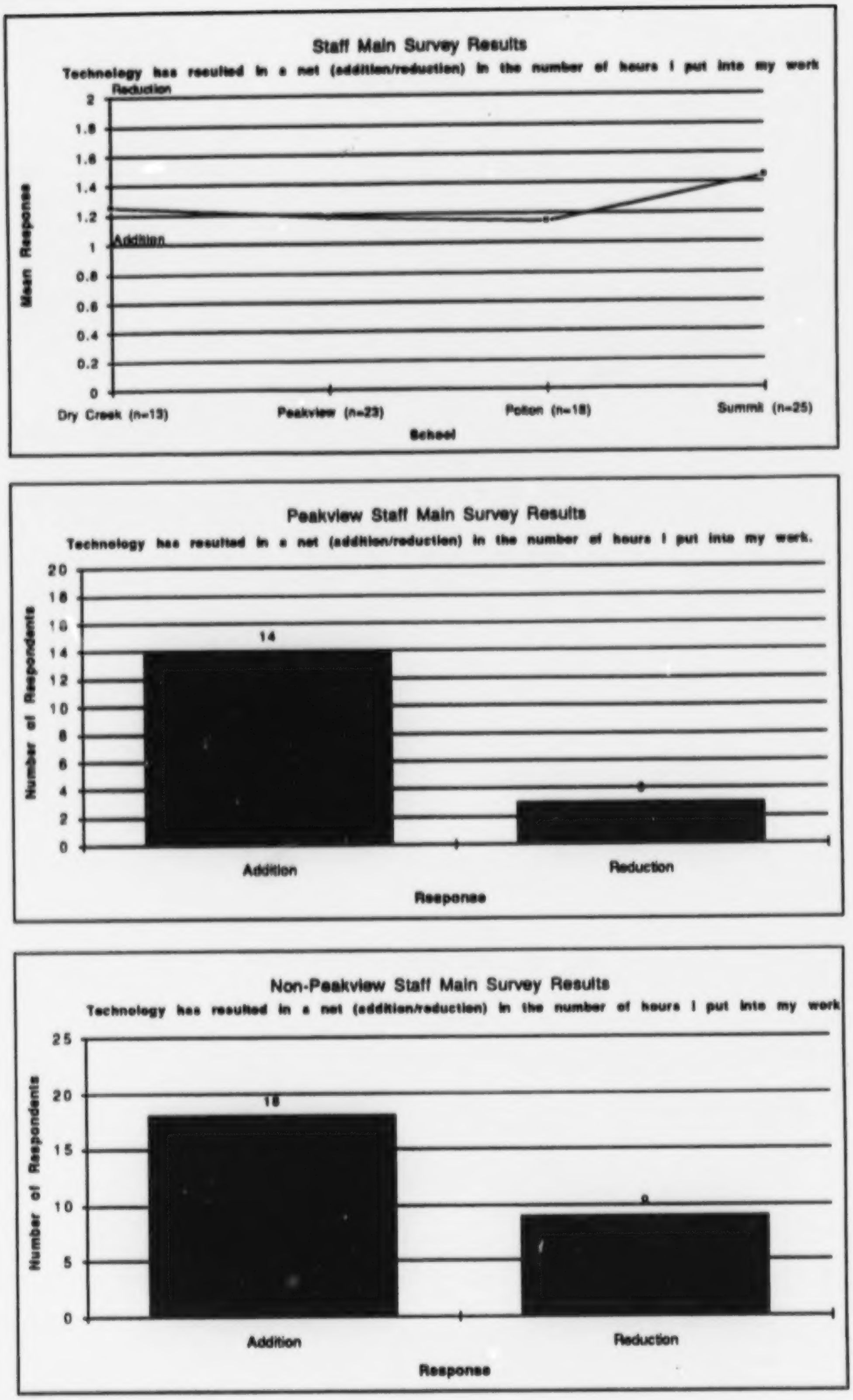
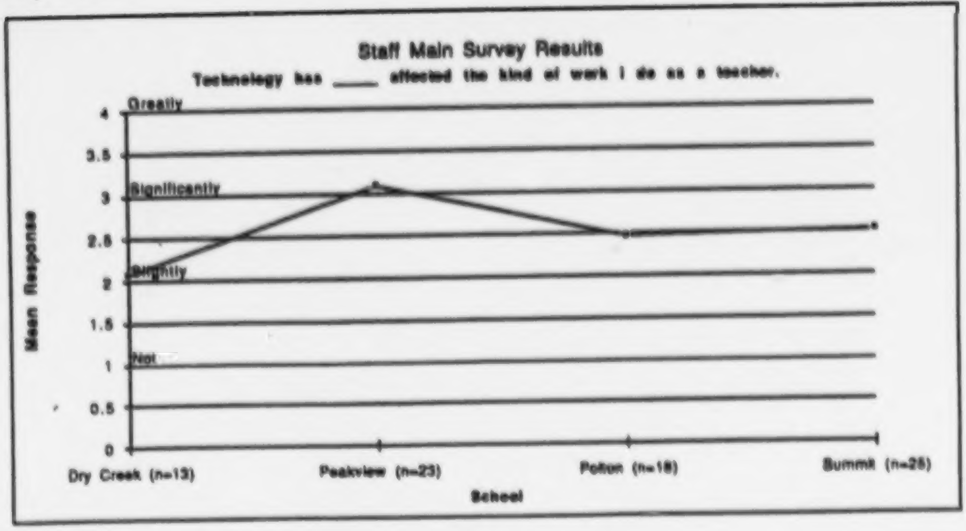
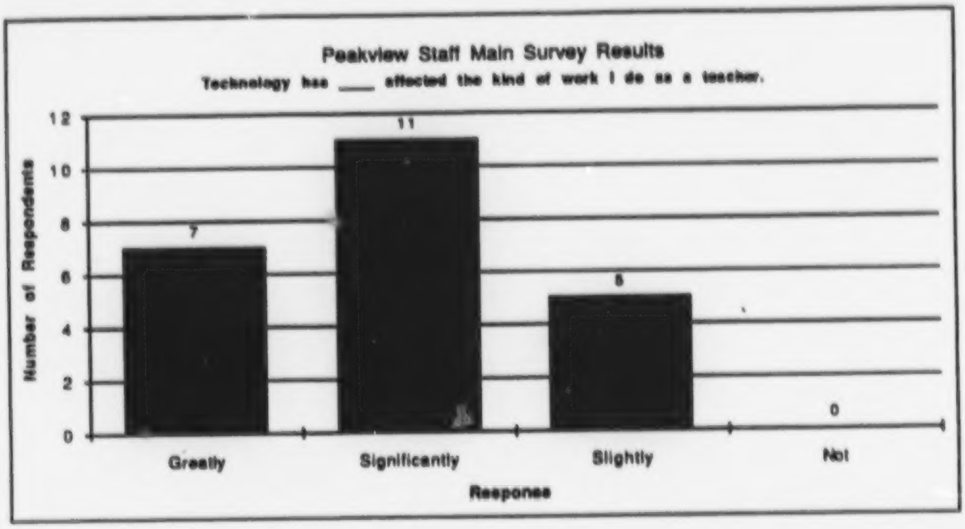

Staff Main Survey Results
Technology has resulted in a net (addition/reduction) in the number of hours I put into my work
Reduction
Addition
Mean Response
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Technology has resulted in a net (addition/reduction) in the number of hours I put into my work.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
14
4
Addition
Reduction
Response
Non-Peakview Staff Main Survey Results
Technology has resulted in a net (addition/reduction) in the number of hours I put into my work
Number of Respondents
25
20
15
10
5
0
18
9
Addition
Reduction
Response

Figure 12.

Figure 13 suggests that technology available at Peakview has significantly affect the kind of work that teachers do. In general, non-Peakview teachers reported only a "slight" effect on their work. A Peakview media specialist emphasizes how critical technology is to her work:

> *The technology is a major part of my day. We have the NOTIS system automated. That's a big piece of what I do...doing interlibrary loan, etc. In addition, I'm helping kids with research, going through Visual Almanac. It was a natural move to the computer rather than the encyclopedia books.* Patricia, media specialist





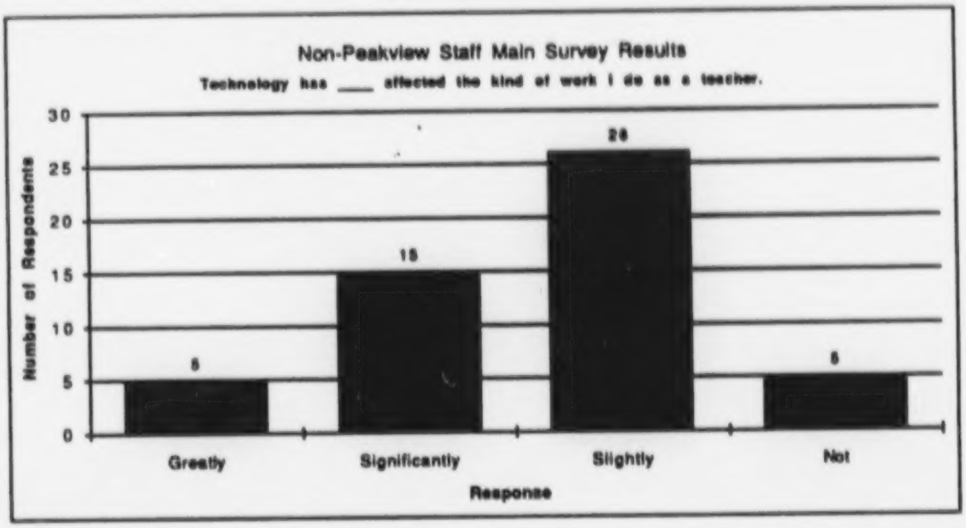


Figure 13.

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All Peakview staff members responding to the Main Survey agreed that technology affects their choice of instructional strategy (Figure 14). Peakview teachers reported a greater impact of technology than non-Peakview teachers ($\chi^2=19.12$, $p<.001$). Nearly all agreed that technology makes their teaching more effective (Figure 15). Again, Peakview teachers reported a stronger effect of technology on their teaching effectiveness than non-Peakview teachers ($\chi^2=9.18$, $p<.05$). All Peakview teachers disagreed that technology is poorly suited to teaching purposes (Figure 16). There was consensus on this question among all four schools.

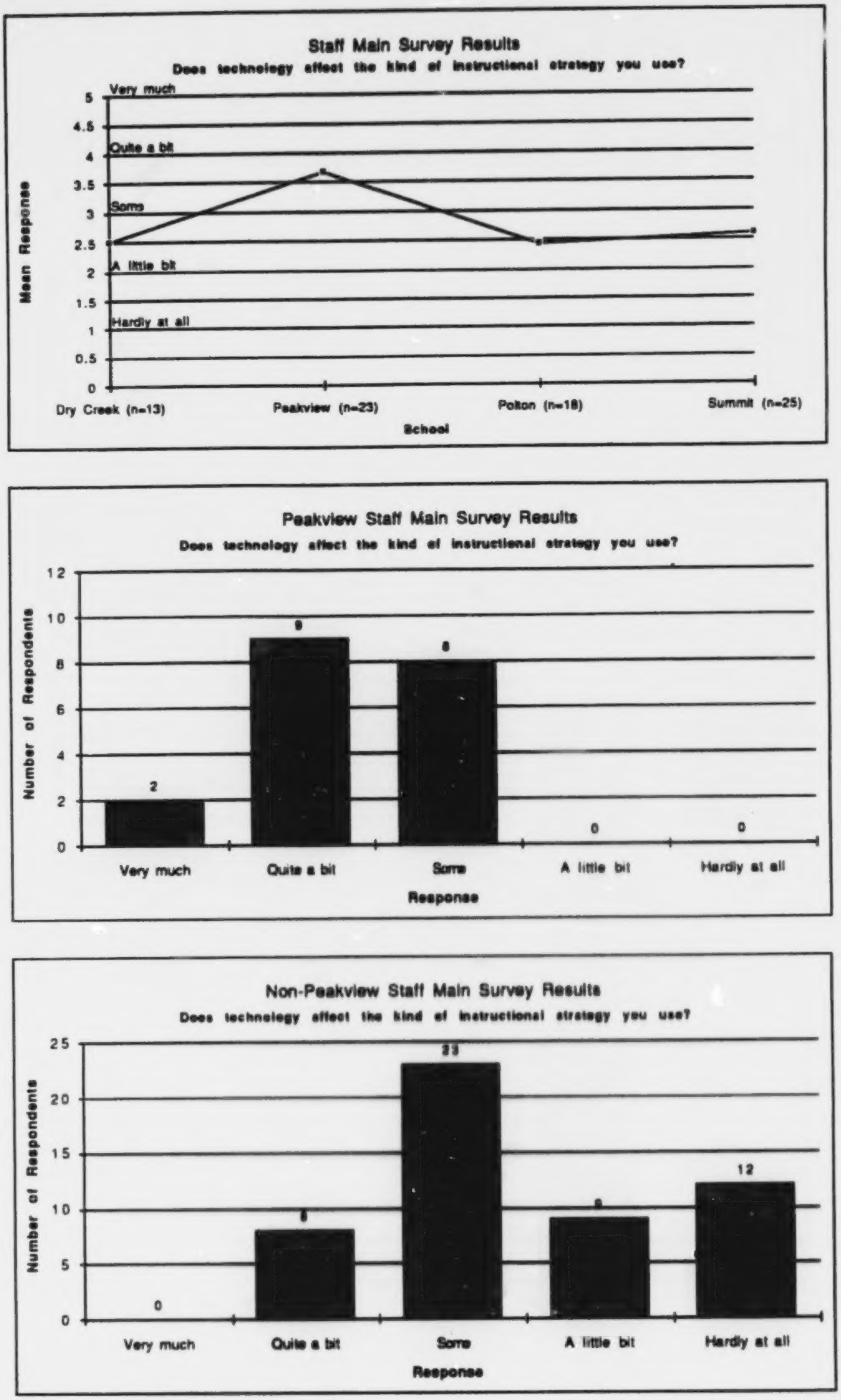

Staff Main Survey Results
Does technology affect the kind of instructional strategy you use?
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Very much
Quite a bit
Some
A little bit
Hardly at all
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Does technology affect the kind of instructional strategy you use?
Number of Respondents
12
10
8
6
4
2
0
2
9
8
0
0
Very much
Quite a bit
Some
A little bit
Hardly at all
Response
Non-Peakview Staff Main Survey Results
Does technology affect the kind of instructional strategy you use?
Number of Respondents
25
20
15
10
5
0
0
8
23
9
12
Very much
Quite a bit
Some
A little bit
Hardly at all
Response

Figure 14.

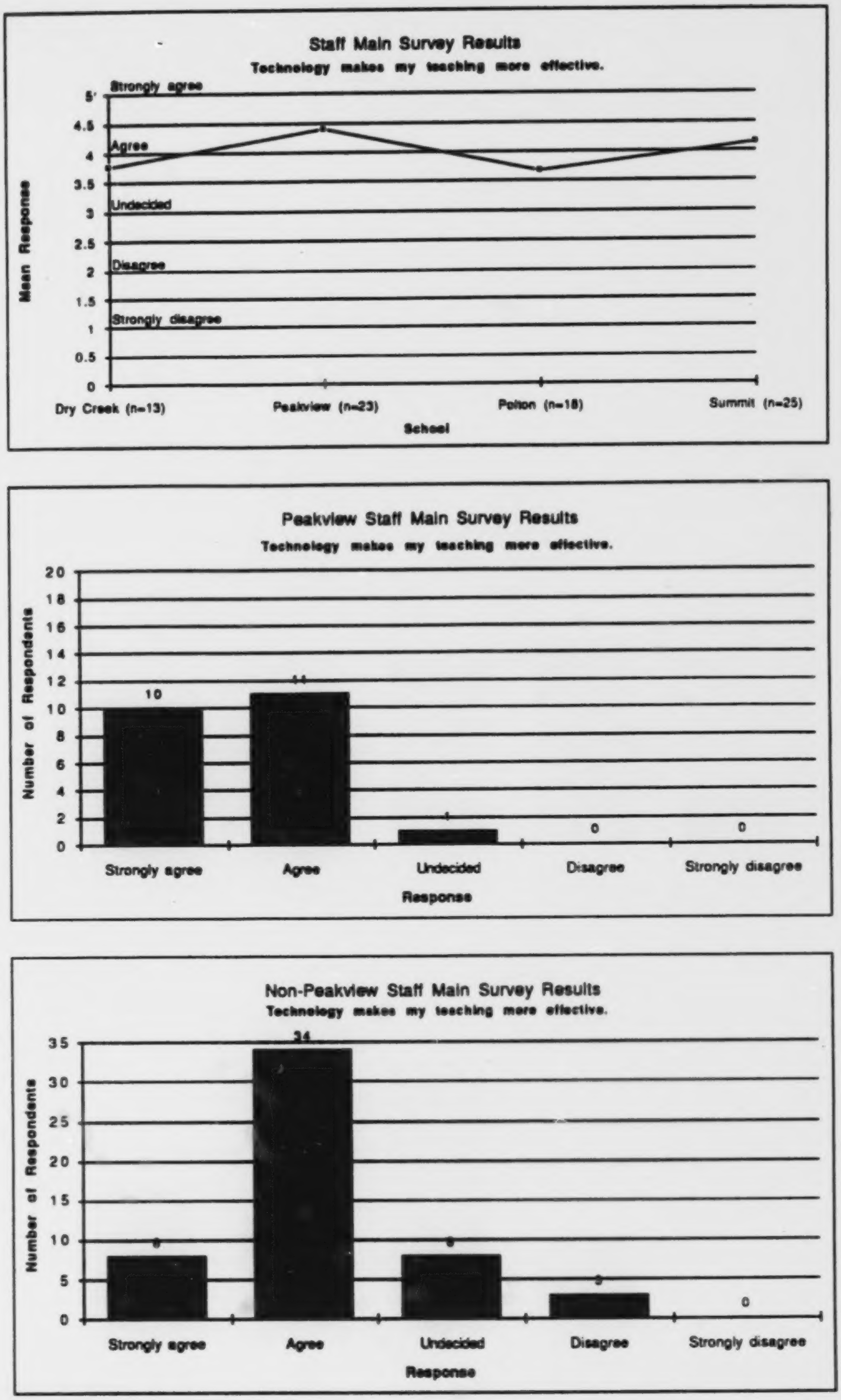
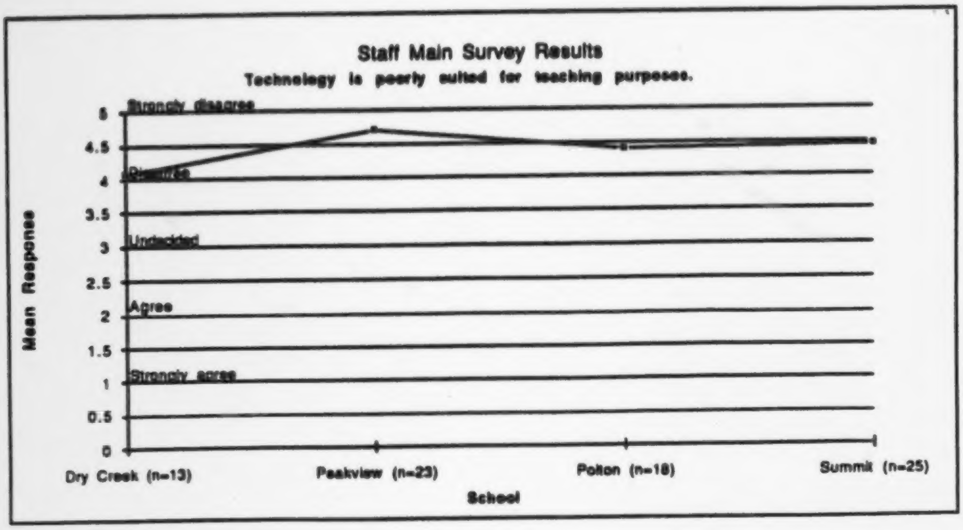
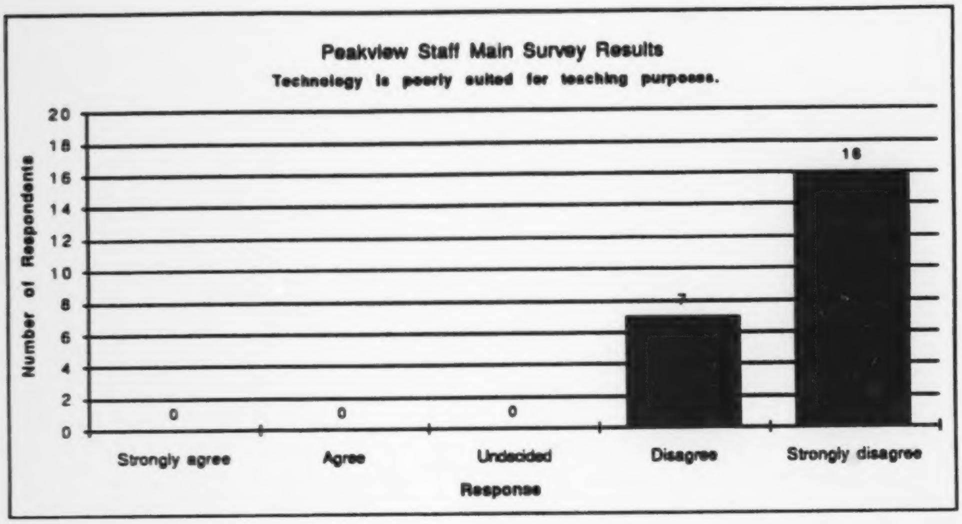

Staff Main Survey Results
Technology makes my teaching more effective.
Mean Response
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Technology makes my teaching more effective.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
10
11
1
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response
Non-Peakview Staff Main Survey Results
Technology makes my teaching more effective.
Number of Respondents
35
30
25
20
15
10
5
0
8
34
8
3
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 15.


Staff Main Survey Results
Technology is poorly suited for teaching purposes.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly disagree
Disagree
Undecided
Agree
Strongly agree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
Technology is poorly suited for teaching purposes.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
0
0
0
7
16
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

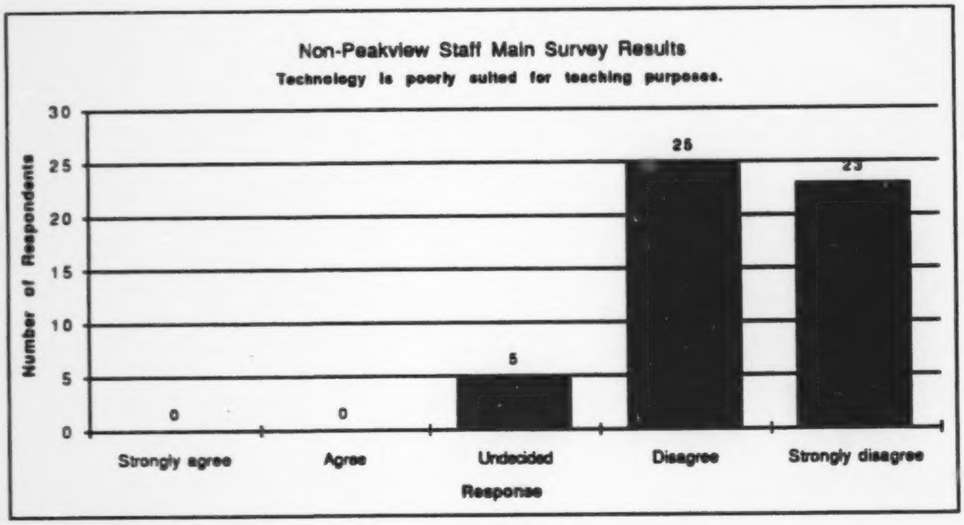

Non-Peakview Staff Main Survey Results
Technology is poorly suited for teaching purposes.
Number of Respondents
30
25
20
15
10
5
0
0
0
5
25
23
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 16.

During interviews at Peakview, teachers were asked, *How has technology affected your everyday teaching routine?* Teachers responded:

> *Teaching has changed a lot in general. We're doing more center-type activities, where computers become just a part of that.* Sandy, primary teacher
>
> *I'm perceiving that I've just taken a step forward, one step of many steps that we are going to take as we continue using technology.* Matt, intermediate teacher
>
> *I guess, more than anything, the exciting part is [that] every time I learn something, there are about five or six directions I can go with it... opens up a lot of new channels.* Nora, Kindergarten teacher
>
> *There's a lot more open-ended time, free flow time where kids are doing a variety of activities, and one of those is computers.* Jennifer, primary teacher
>
> *It's great that they're learning. That's what they're here for and that's what I'm here for. I'm delighted whenever it happens; and if the tool makes something happen for some child without me, then that frees me up to work with some other child who needs me. Anything that extends my ability is terrific.* Lynn, primary teacher
>
> *Looking forward to refocusing, developing goals, making changes in the classroom. This fall will be the big push.* Elizabeth, intermediate teacher

Our data indicate general consensus among staff members that technology affects the instructional strategies teachers use in a positive way. Teachers report doing their jobs more effectively with the use of technology.

## Ability Levels

For several subjects, we asked teachers two related questions: *How important is a particular effect or outcome in your teaching,* and *What effect does technology have on your accomplishing that outcome?* For example, when asked, *Does technology help you meet the needs of students of exceptionally high or low ability?*, 19 of 20 staff members at Peakview responded 'yes' (Figure 17). All four schools concurred on this question.

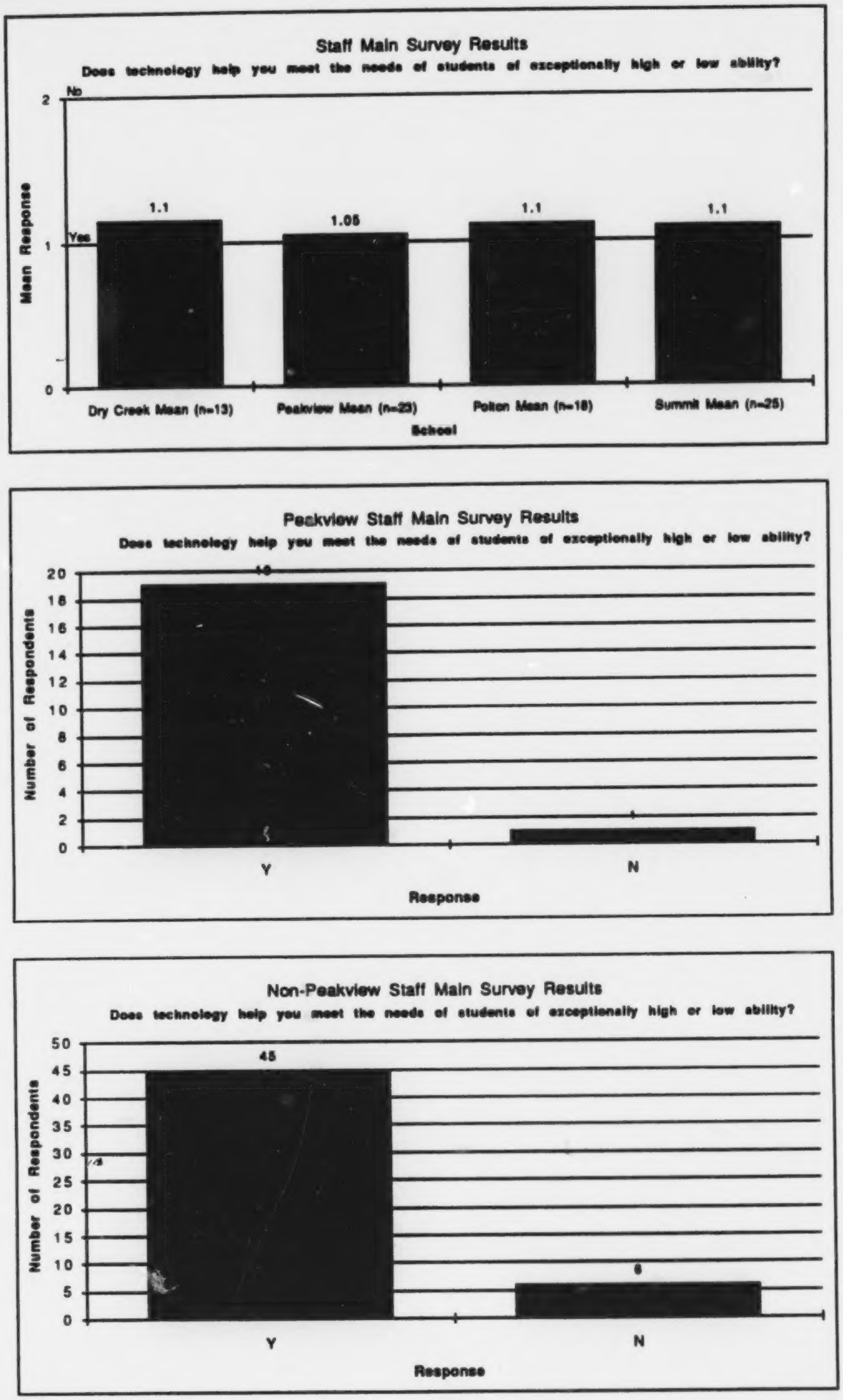


Figure 17.

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Several Peakview teachers reflected on technology's potential for accommodating different ability levels:

> *Some of the best pieces of work come out from the computer. I have a wheelchair student. He performs well on the computer. It's a different avenue and they are able to use it to their best potential.* Charlotte, primary teacher
>
> *Kids are very excited about using the technology. A lot of kids are more excited about school in general...high-level kids who like to go the extra mile. We have more and more kids who like school.*
>
> *The lower achievers have more of an opportunity to do some writing. It's easier to proofread and edit.* Matt, intermediate teacher
>
> *It is a lot more motivating for kids struggling, especially kids who are having trouble with reading. They feel more comfortable with the information.* Tom, intermediate teacher
>
> *High achievers also are particularly helped... making HyperCard stacks.* Ginny, primary teacher
>
> *I have some very gifted children that are doing HyperCard stack development on their own... first and second graders.* Sandy, primary teacher

## Small-Group Instruction

The scale of Figure 18 shows a mix of whole-class and small-group activities at all four schools, with Peakview teachers reporting greater use of small-group activities ($\chi^2=4.94$, $p<.05$). This difference between Peakview and non-Peakview may be attributable to differences in philosophy; however, Figure 19 shows Peakview teachers reporting that technology affects their use of small-group activities. This is significantly more than reported from comparison schools ($\chi^2=4.13$, $p<.05$).

Thus it seems that the differences in small-group activities reported at Peakview can be attributed in part to the technology available. Additional results concerning whole-class vs. small-group activities are presented in the Student Achievement section below.

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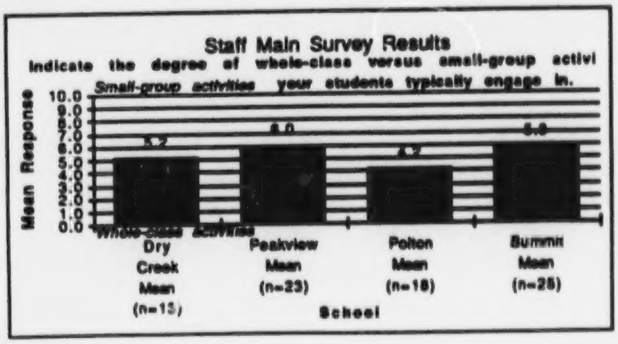
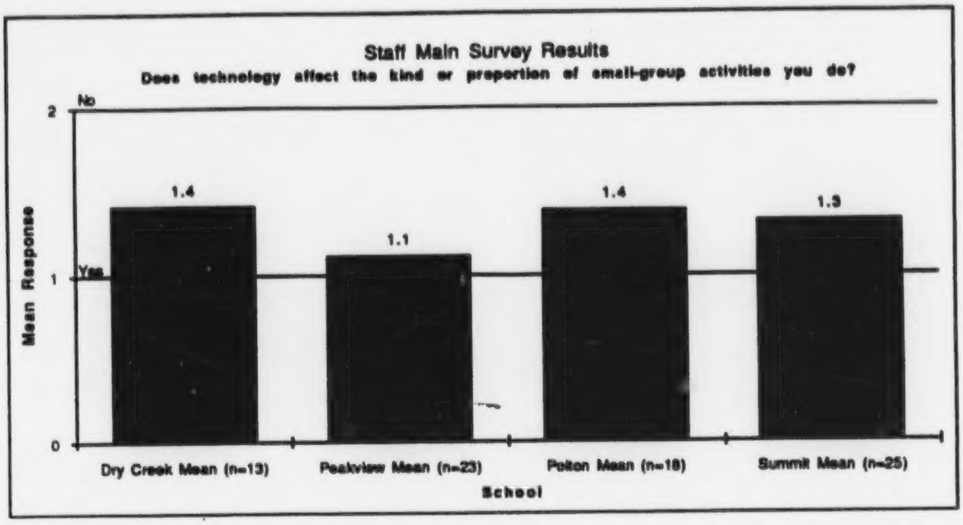


Figure 18.



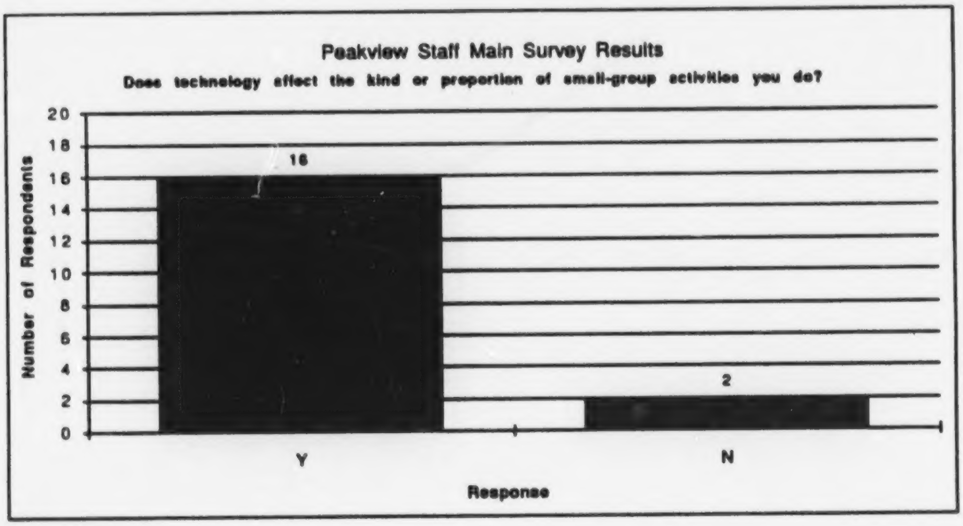


Figure 19.

Teachers commented that small-group strategies can become more feasible with technology:

> *It does make me able to work with more small groups. Specific skill areas. Less whole-class things than in the past...3-4-5 (multi-aging) and technology combined play a factor in that...writing and written work especially.* Kate, intermediate teacher

> *As a teacher I always would rather be seen as a coach rather than the all knowing.* Sandy, primary teacher

## Competition Versus Cooperation

Figure 20 indicates a strong majority (14 of 16 or 88%) of Peakview teachers reported that technology affects their use of cooperative learning activities. Peakview's response to this question was dramatically different from the non-Peakview schools ($\chi^2=15.80$, $p<.001$). As shown by the scale in Figure 21, Peakview's teachers reported using cooperative learning activities more than their counterparts ($F=5.37$, $p<.05$).

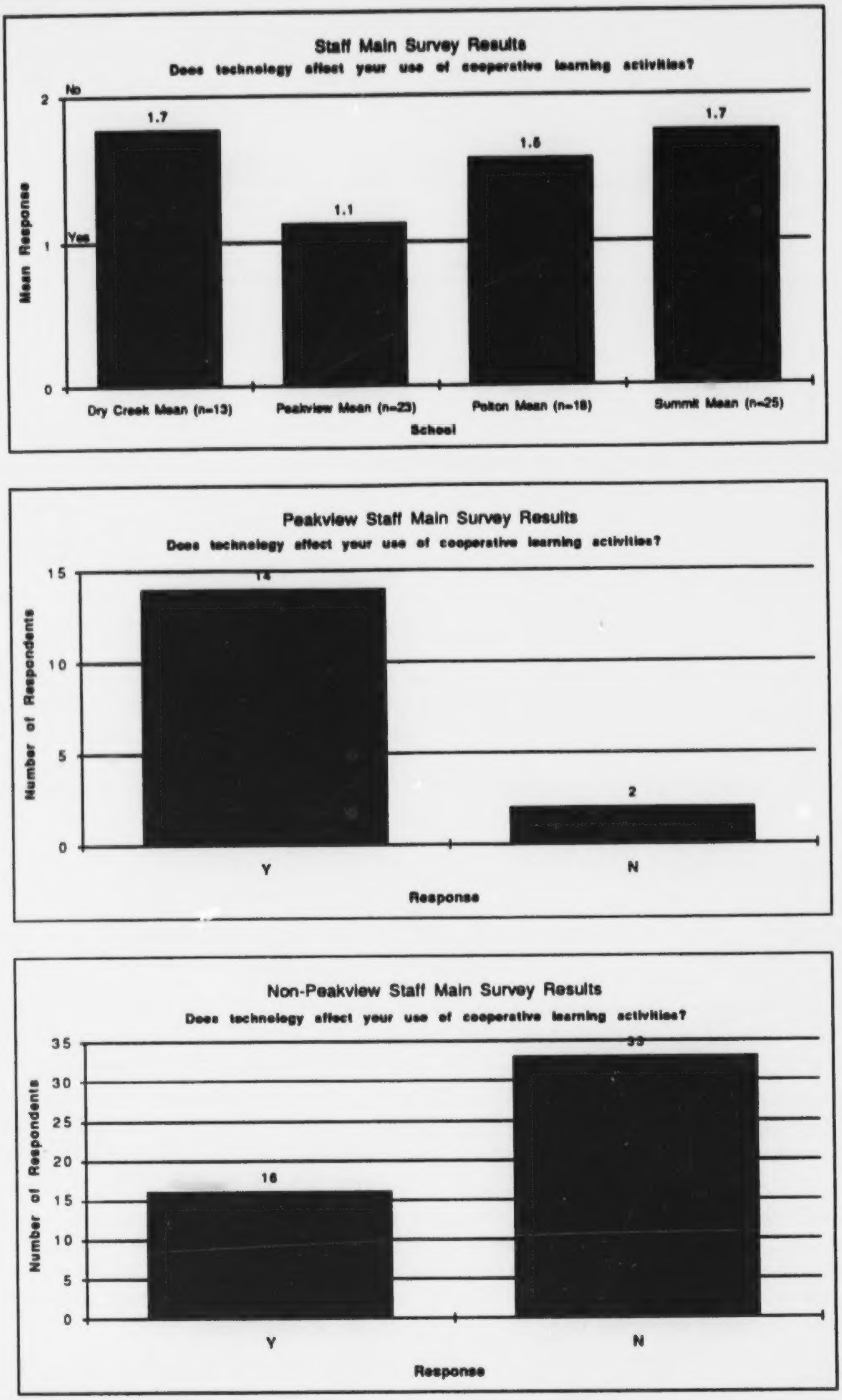

Staff Main Survey Results
Does technology affect your use of cooperative learning activities?
Mean Response
2
1
0
No
Yes
1.7
1.1
1.6
1.7
Dry Creek Mean (n=13)
Peakview Mean (n=23)
Polton Mean (n=18)
Summit Mean (n=25)
School
Peakview Staff Main Survey Results
Does technology affect your use of cooperative learning activities?
Number of Respondents
15
10
5
0
14
2
Y
N
Response
Non-Peakview Staff Main Survey Results
Does technology affect your use of cooperative learning activities?
Number of Respondents
35
30
25
20
15
10
5
0
16
33
Y
N
Response

Figure 20.

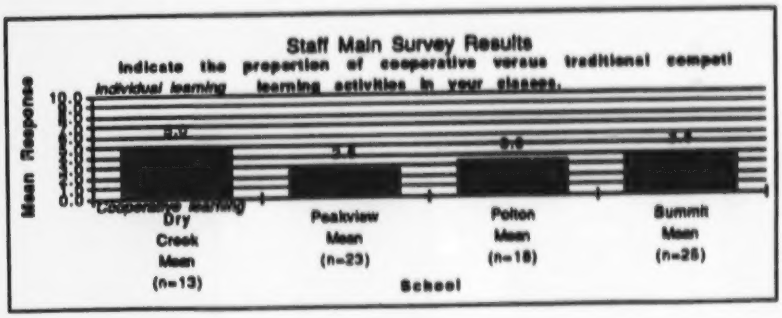


Figure 21.

Peakview staff members indicated that technology facilitates cooperative learning strategies:

> *[Technology provided a] terrific unifying type of a goal for us as a school to come together. I've seen that building-wide, a whole new thrust for us relating to technology. I've seen a tremendous burst of cooperative learning because of computers... extended learning between classroom and media center. We only showed the kids one program at the beginning of the year. Now they're into every single program that's there. They learn on their own, how to go into folders and get things...Munchers, Reader Rabbit, etc.* Nora, Kindergarten teacher

> *[They have a] sense of control over their own learning. Cooperative learning is enhanced because the nature of the computers and available guides requires that they help each other... there's not enough adults.* Lynn, primary teacher

Again we have a teaching strategy that is generally valued by teachers and enhanced by technology. Peakview teachers report that technology has an impact on their use of the strategy; indeed, they report using the strategy more than their counterparts at other schools.

## Time On Task

There was strong agreement with the statement, *Students work more productively when I use technology* at Peakview, with 20 of 22 (91%) of staff members indicating agreement (Figure 22). Peakview teachers differed from non-Peakview teachers on this question ($\chi^2$=11.55, p<.01). Peakview teachers also agreed that technology makes a subject more interesting (Figure 23), which may contribute to greater student time on task. Similar results were obtained at the comparison schools. Unlike the comparison groups ($\chi^2$=10.46, p<.05), all 21 Peakview staff members disagreed that students are less attentive when technology is used in teaching Figure 24). Although teachers were not asked about discipline problems and technology, it is possible that students exhibit fewer behavioral problems when engaged with technology. This would be consistent with other research on technology-related activities (e.g., Dwyer, Ringstaff, & Sandholtz, 1991).

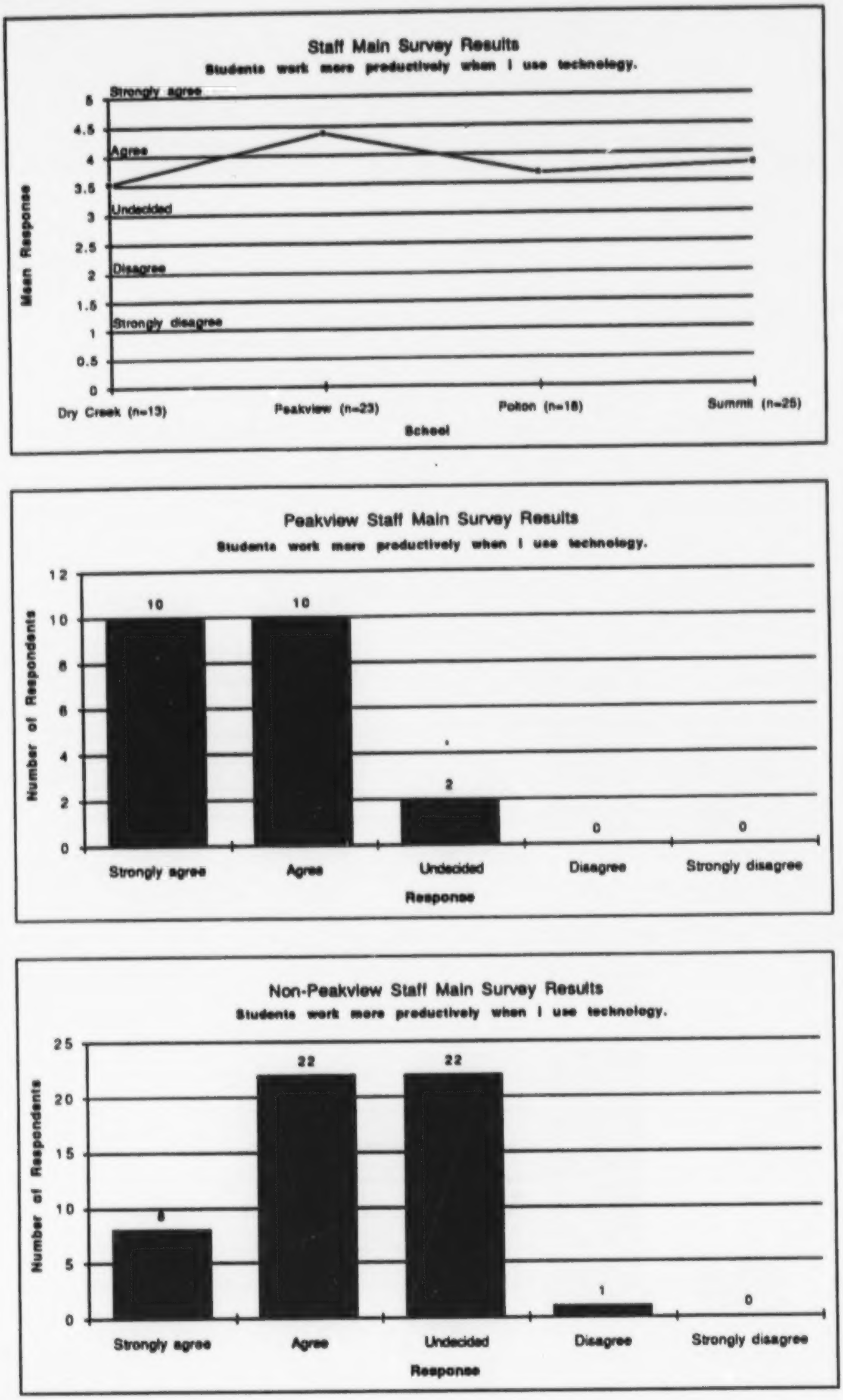


Figure 22.

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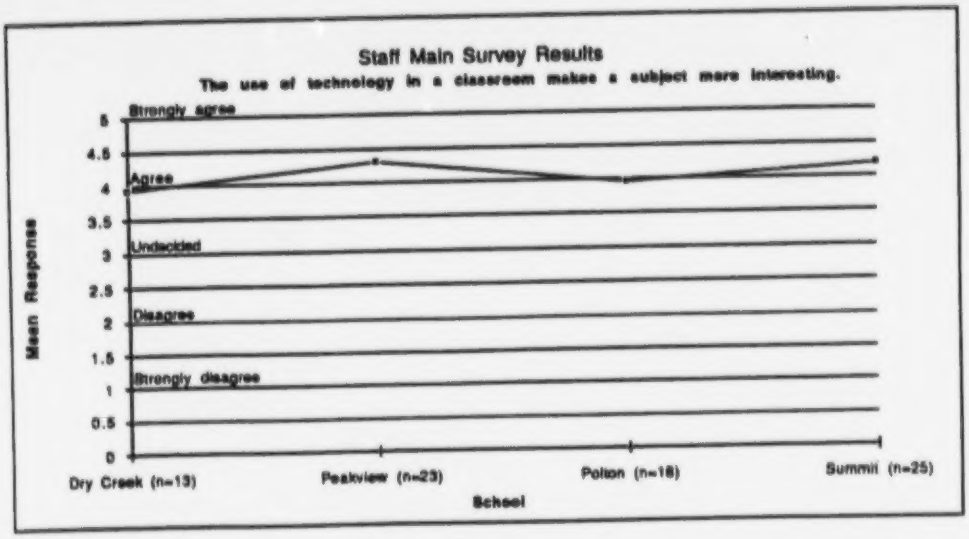
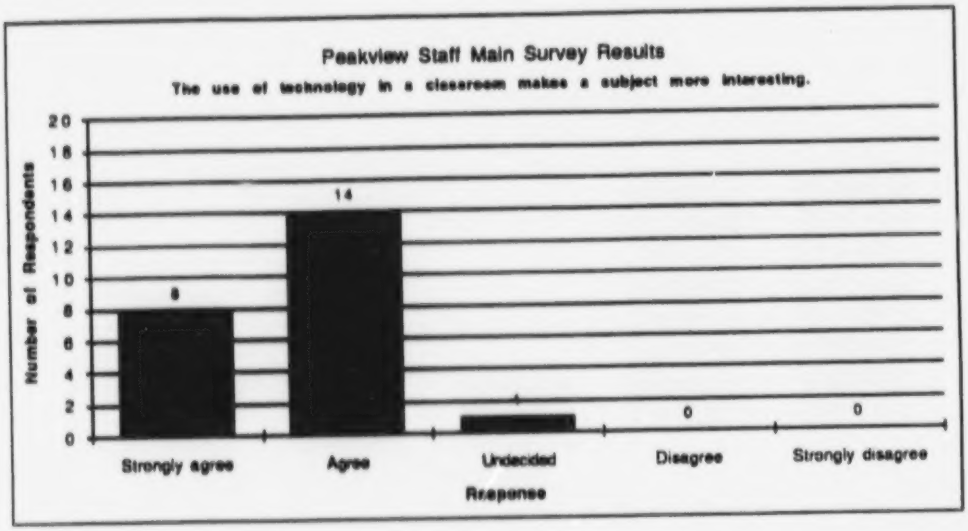

Staff Main Survey Results
The use of technology in a classroom makes a subject more interesting.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
The use of technology in a classroom makes a subject more interesting.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
8
14
1
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

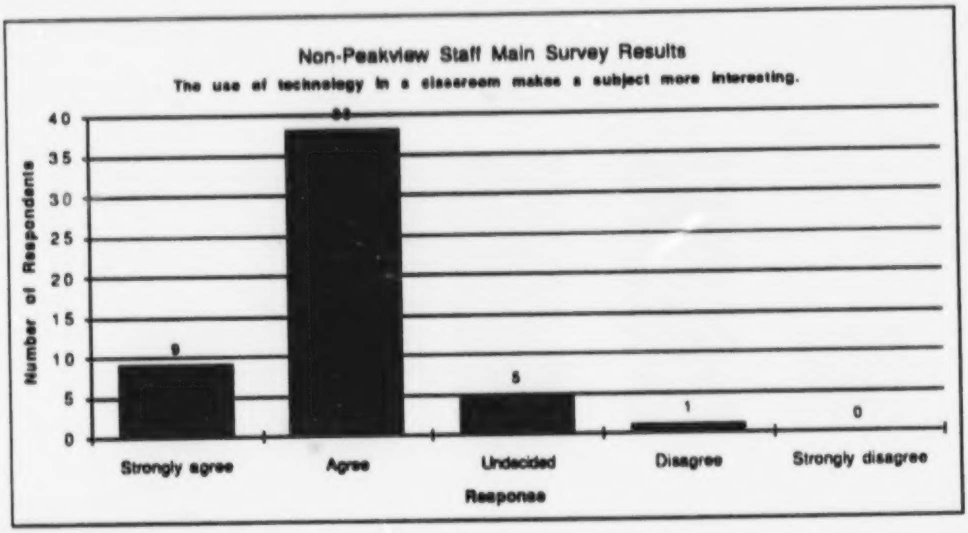

Non-Peakview Staff Main Survey Results
The use of technology in a classroom makes a subject more interesting.
Number of Respondents
40
35
30
25
20
15
10
5
0
9
5
1
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 23.

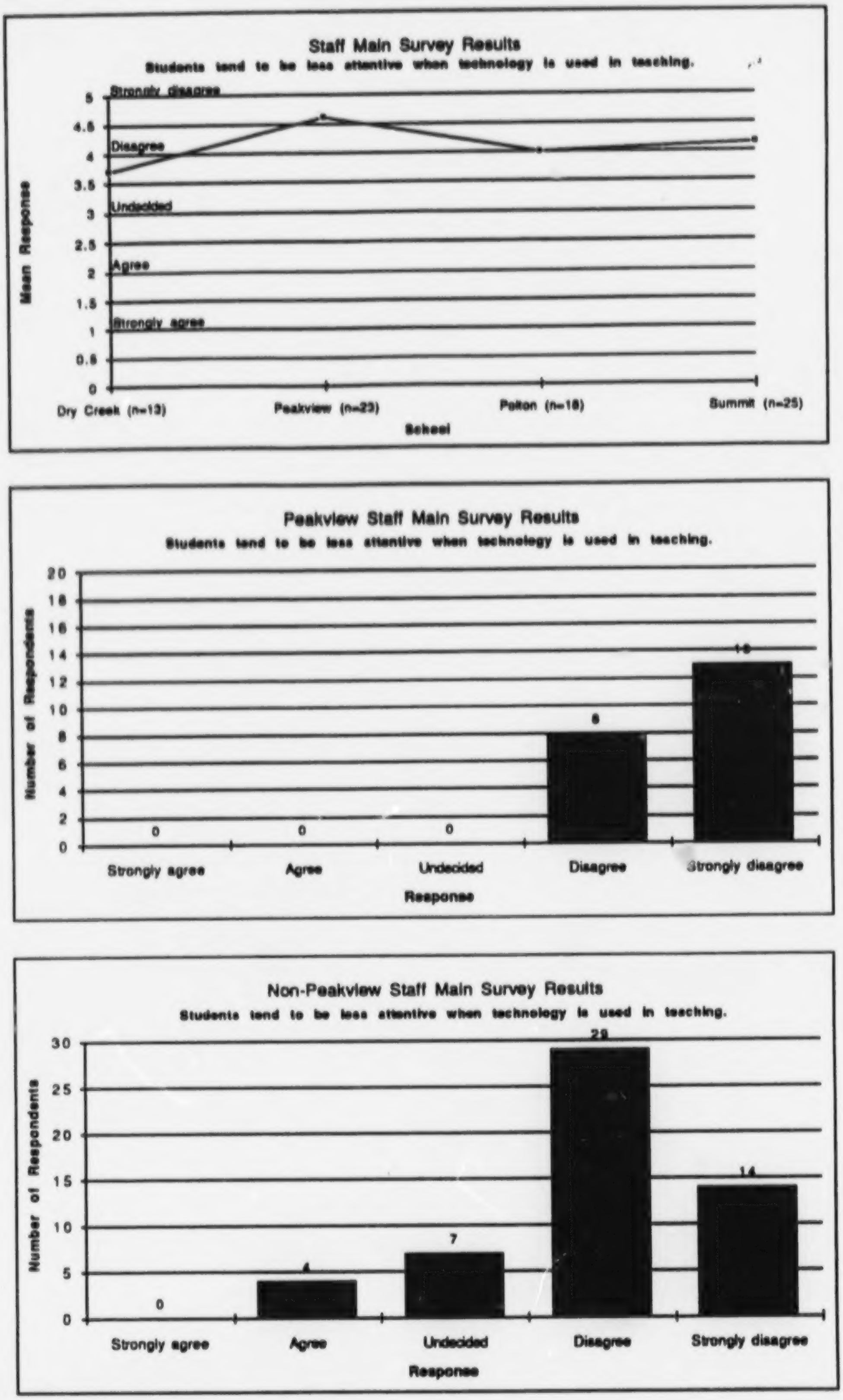

Staff Main Survey Results
Students tend to be less attentive when technology is used in teaching.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly disagree
Disagree
Undecided
Agree
Strongly agree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Students tend to be less attentive when technology is used in teaching.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
0
0
0
8
15
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response
Non-Peakview Staff Main Survey Results
Students tend to be less attentive when technology is used in teaching.
Number of Respondents
30
25
20
15
10
5
0
0
4
7
29
14
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 24.

In summary, the evidence from Peakview is consistent with other research findings (summarized in Collins, 1991) wherein students are observed to remain engaged with technology-related tasks. When students are engaged in meaningful learning task, greater learning is likely to occur.

## Self-Directed Learning

The next several sections continue to examine teachers' priorities teaching the perceived impact of technologies on those priorities. Again, the reasoning underlying these questions is first, to gauge how much teachers value a certain approach, then second, to determine whether technology might contribute to facilitating that approach in the classroom.

Figure 25 shows that 77% of the 22 Peakview staff members ranked students' self-directed learning as 'top priority' in importance to their teaching; teachers at other schools' viewed self-directed learning lower in priority ($\chi^2$=13.17, p<.05). Consistent with their priorities, Figure 26 shows that 81% of the Peakview teachers reported that technology has a "heavy" influence on their students' self-directed learning, compared to only 6% of the non-Peakview teachers ($\chi^2$=42.60, p<.001). This is a dramatic difference, clearly indicating that at Peakview, technology is seen as a vehicle for accomplishing more self-directed learning, which teachers value highly as a learning outcome.

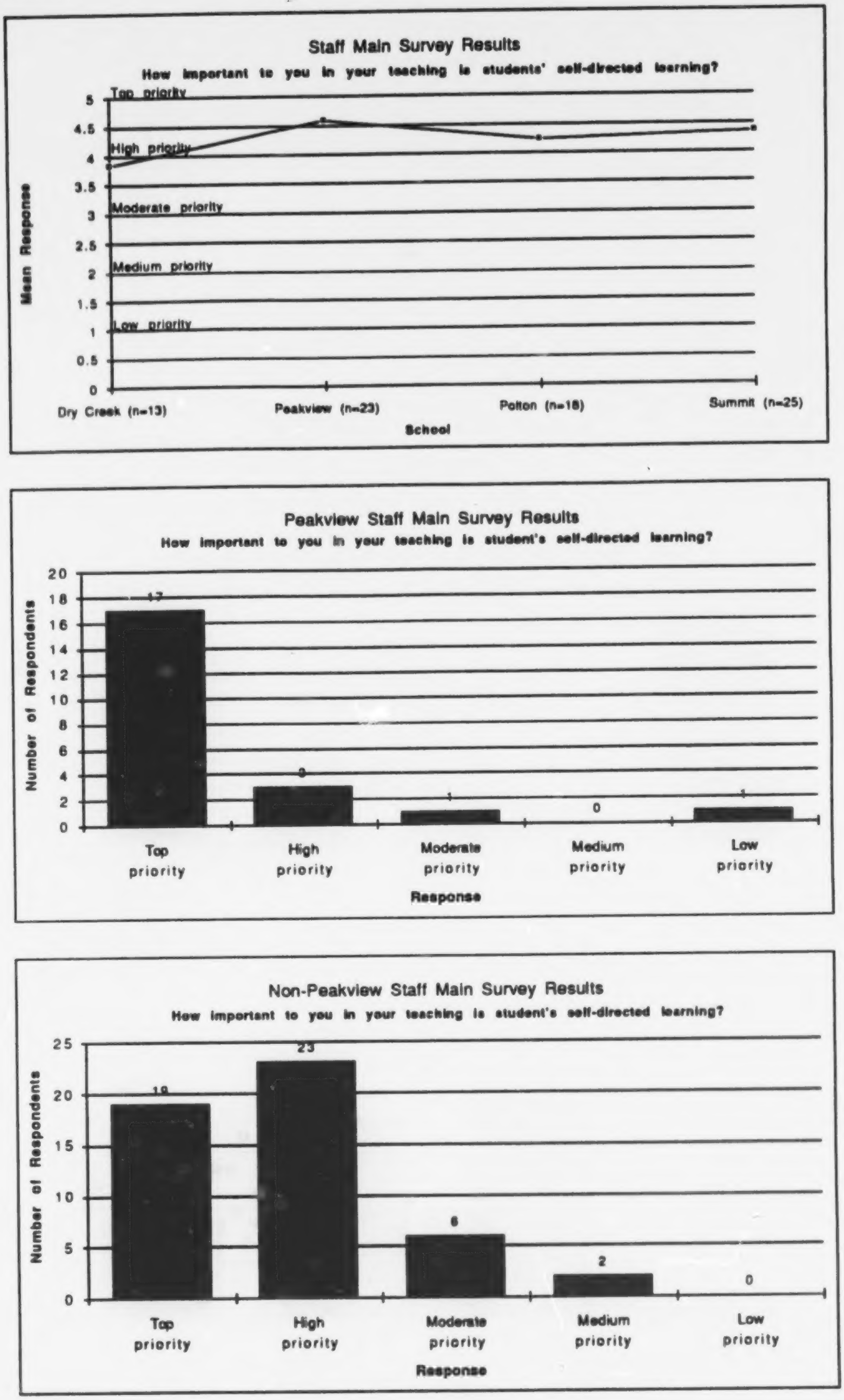


Figure 25.

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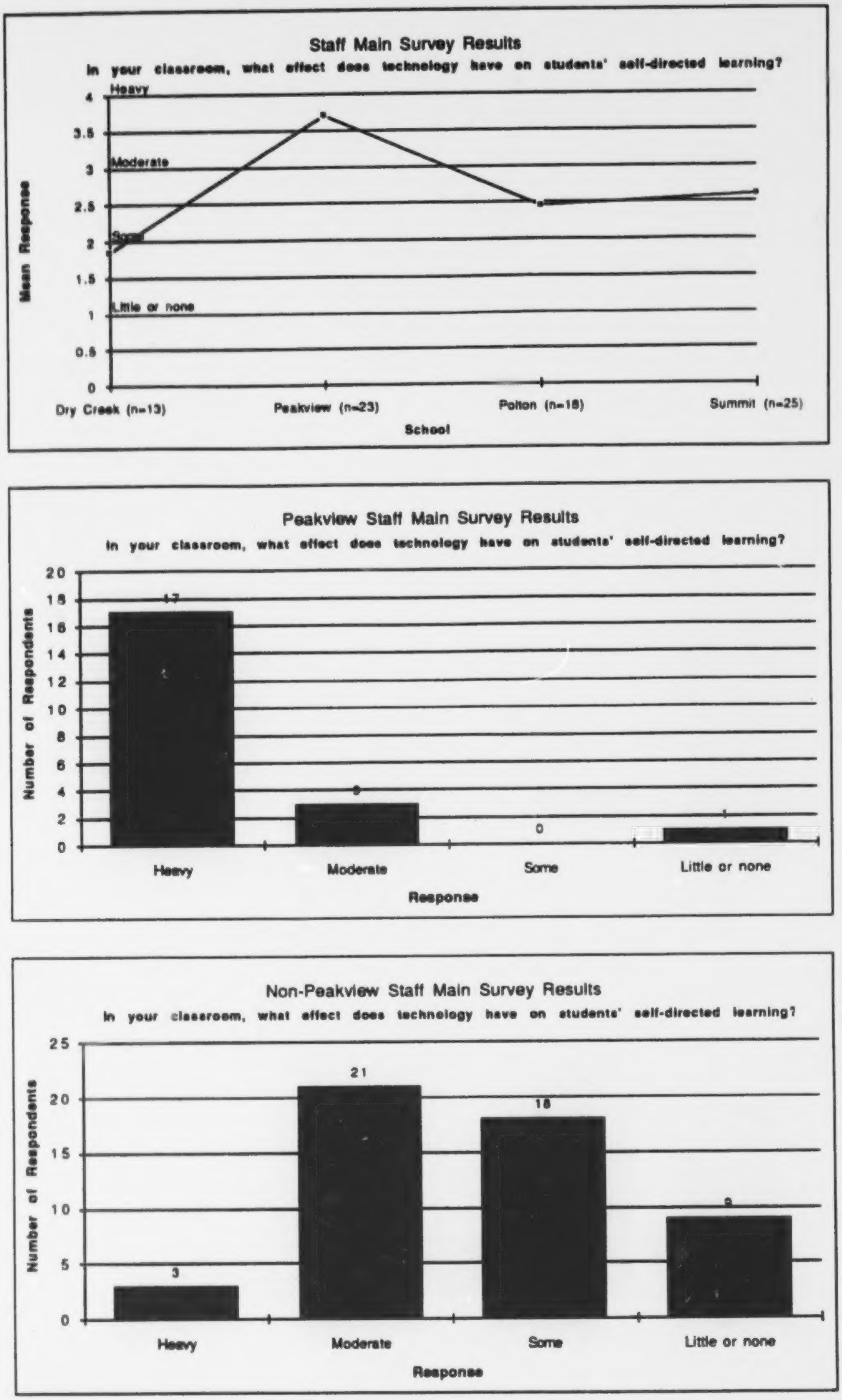

Staff Main Survey Results

In your classroom, what effect does technology have on students' self-directed learning?

Peakview Staff Main Survey Results

In your classroom, what effect does technology have on students' self-directed learning?

Non-Peakview Staff Main Survey Results

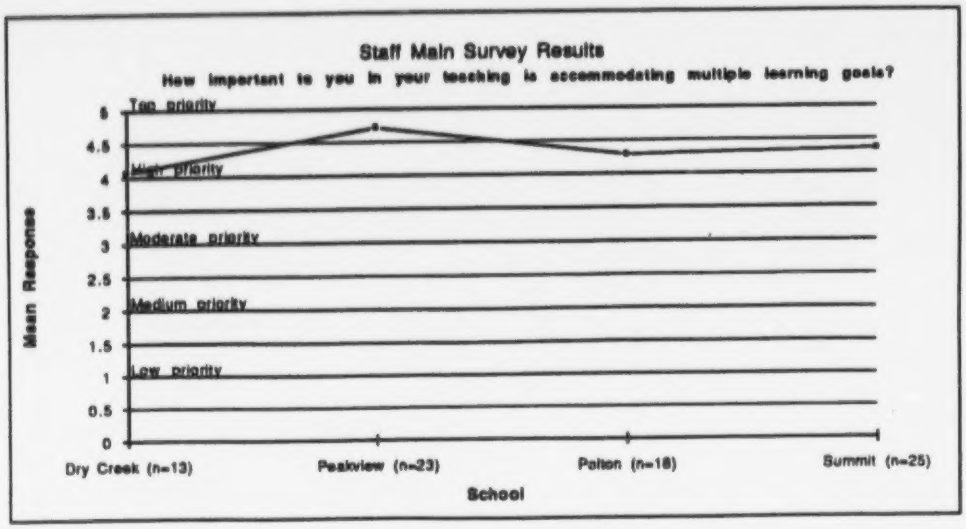
In your classroom, what effect does technology have on students' self-directed learning?

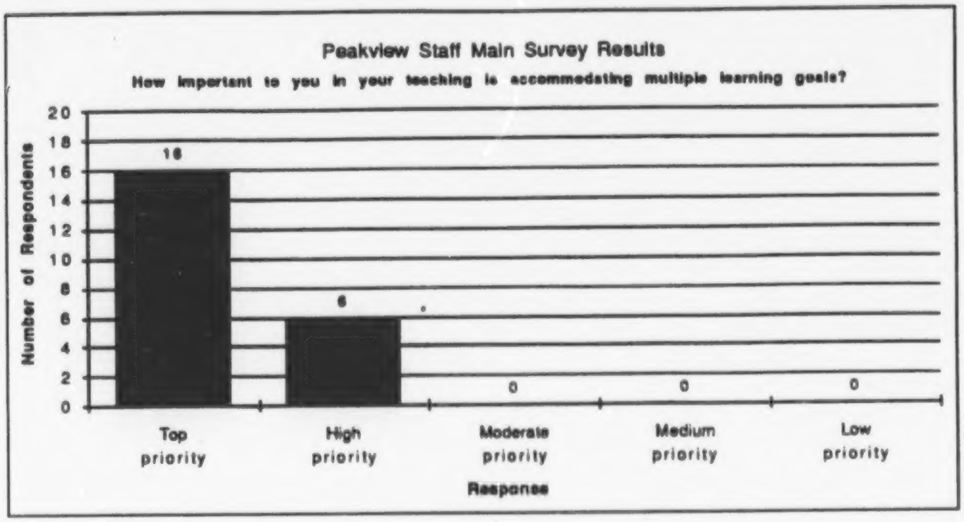
Heavy
Moderate
Some
Little or none
Mean Response
0
0.5
1
1.5
2
2.5
3
3.5
4
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Number of Respondents
0
2
4
6
8
10
12
14
16
18
20
17
3
0
1
Heavy
Moderate
Some
Little or none
Response
Number of Respondents
0
5
10
15
20
25
3
21
18
9
Heavy
Moderate
Some
Little or none
Response

Figure 26.

## Accommodation of Multiple Learning Goals

In a typical classroom, students often work at different achievement levels and on tasks that address different learning goals. Yet managing a classroom full of students working on different goals is a challenge. To assess the impact of technology relative to this problem, we first asked teachers about the importance they attached to multiple learning goals. 'Top priority' or 'high priority' was the response given by all the Peakview teachers, with a similar response across all four schools (Figure 27). As shown in Figure 28, the effect of technology on accommodating multiple learning goals in the classroom was rated as 'heavy' or 'moderate' by 19 of 21 Peakview staff members. This effect was much higher that those reported by teachers at comparison schools ($\chi^2=31.64$, $p<.001$). All 22 of the Peakview teachers agreed that using technology can help accommodate multiple learning goals (Figure 29), more than non-Peakview teachers ($\chi^2=11.70$, $p<.01$).


Staff Main Survey Results
How important to you in your teaching is accommodating multiple learning goals?
Top priority
High priority
Moderate priority
Medium priority
Low priority
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek (n=13)
Peakview (n=23)
Palton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
How important to you in your teaching is accommodating multiple learning goals?
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
16
6
0
0
0
Top priority
High priority
Moderate priority
Medium priority
Low priority
Response

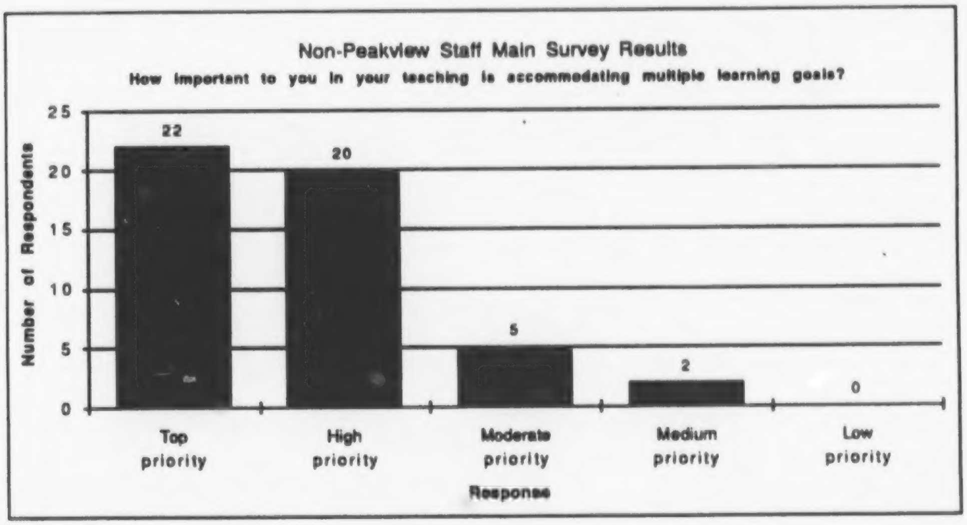

Non-Peakview Staff Main Survey Results
How important to you in your teaching is accommodating multiple learning goals?
Number of Respondents
25
20
15
10
5
0
22
20
5
2
0
Top priority
High priority
Moderate priority
Medium priority
Low priority
Response

Figure 27.

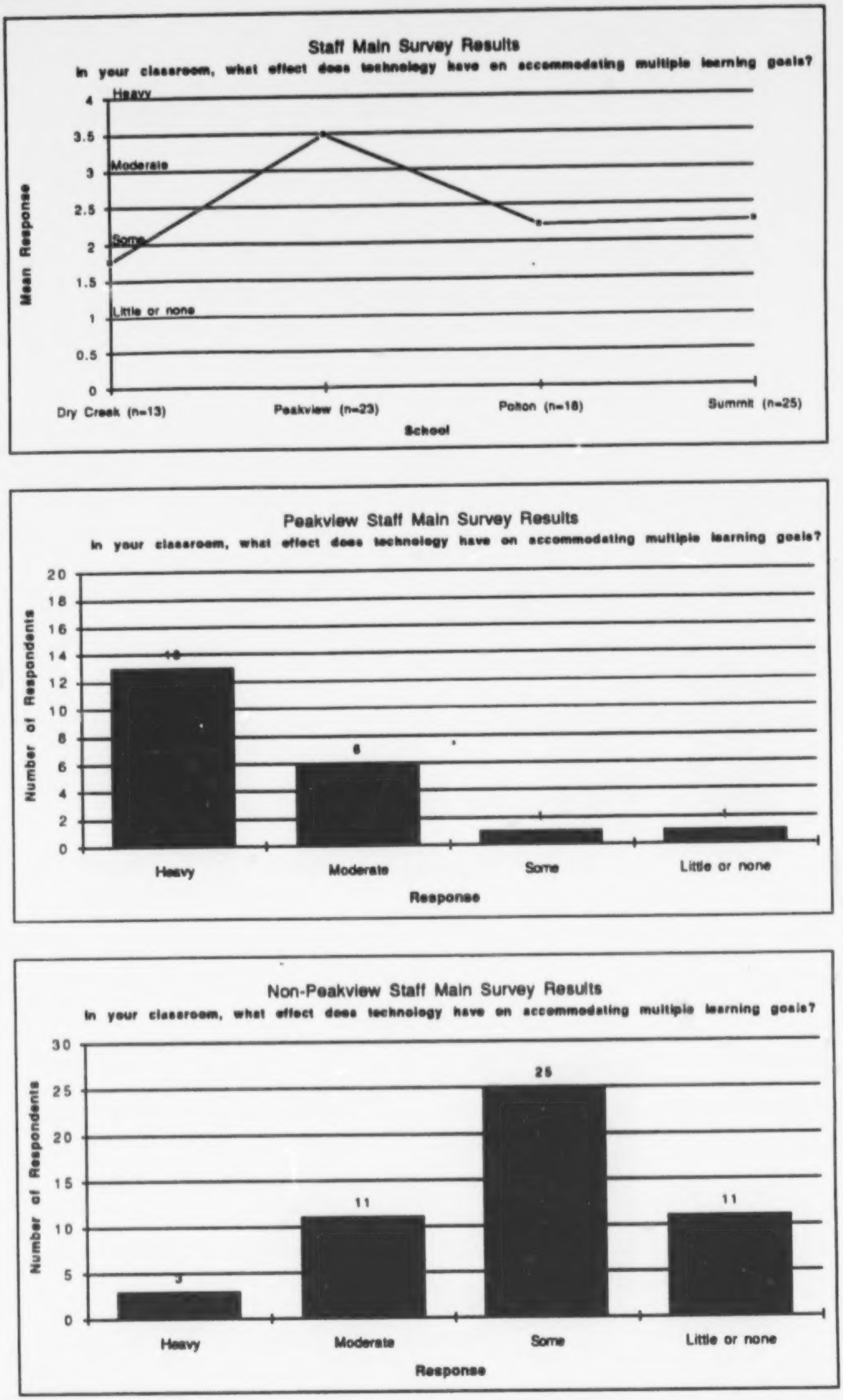
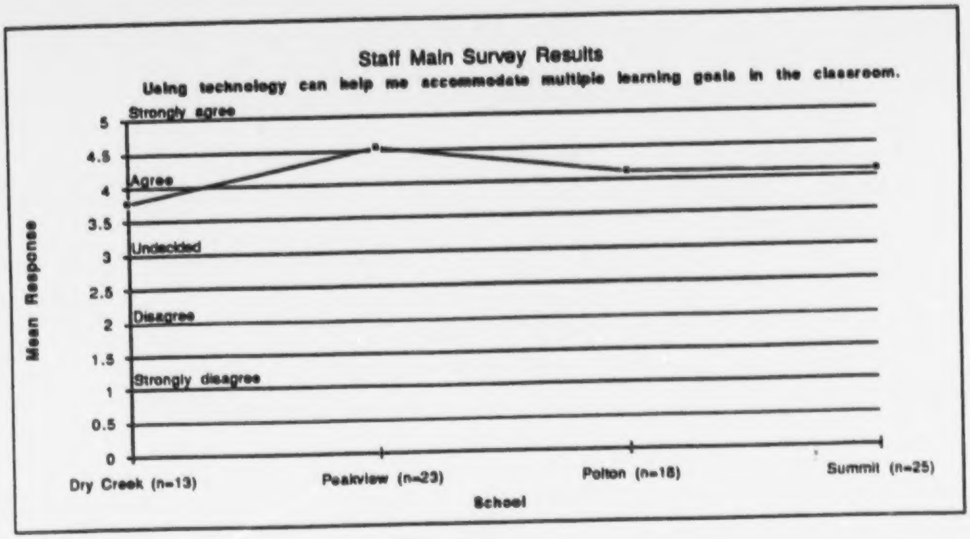
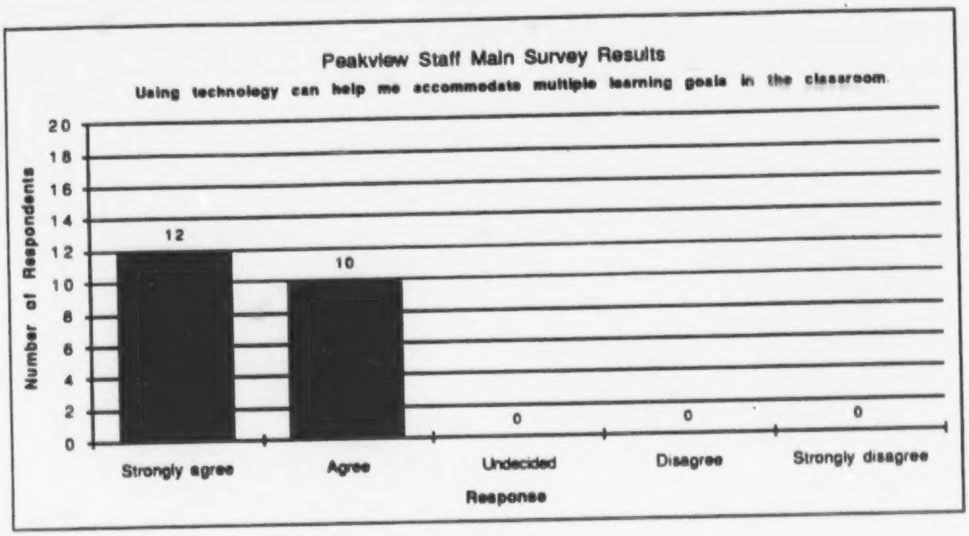

Staff Main Survey Results
In your classroom, what effect does technology have on accommodating multiple learning goals?
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
Heavy
Moderate
Some
Little or none
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
In your classroom, what effect does technology have on accommodating multiple learning goals?
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
13
6
Heavy
Moderate
Some
Little or none
Response
Non-Peakview Staff Main Survey Results
In your classroom, what effect does technology have on accommodating multiple learning goals?
Number of Respondents
30
25
20
15
10
5
0
3
11
25
11
Heavy
Moderate
Some
Little or none
Response

Figure 28.


Staff Main Survey Results
Using technology can help me accommodate multiple learning goals in the classroom.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
Using technology can help me accommodate multiple learning goals in the classroom.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
12
10
0
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

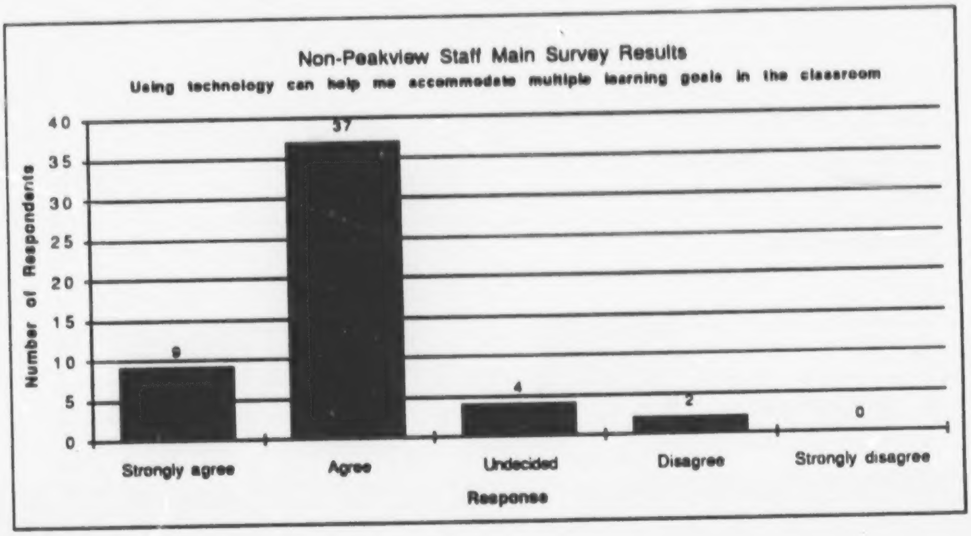

Non-Peakview Staff Main Survey Results
Using technology can help me accommodate multiple learning goals in the classroom
Number of Respondents
40
35
30
25
20
15
10
5
0
9
37
4
2
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

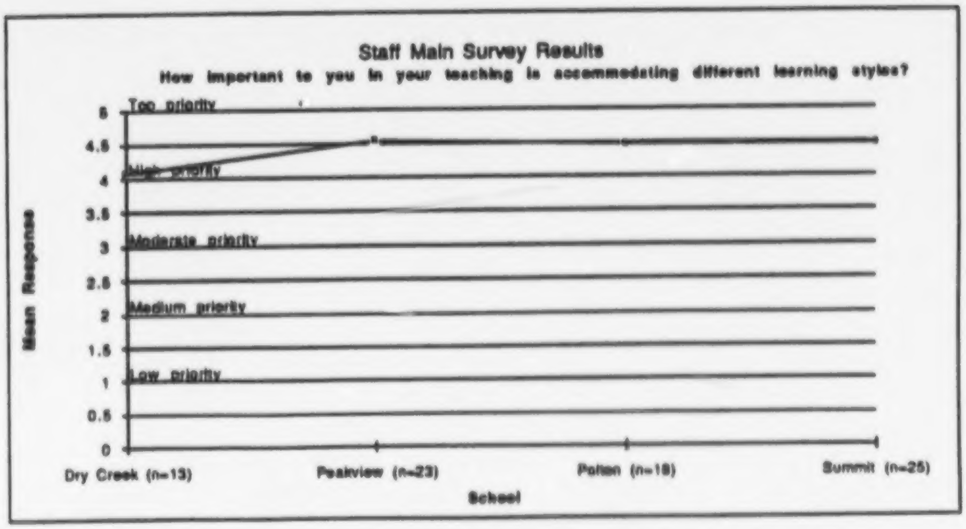
Figure 29.

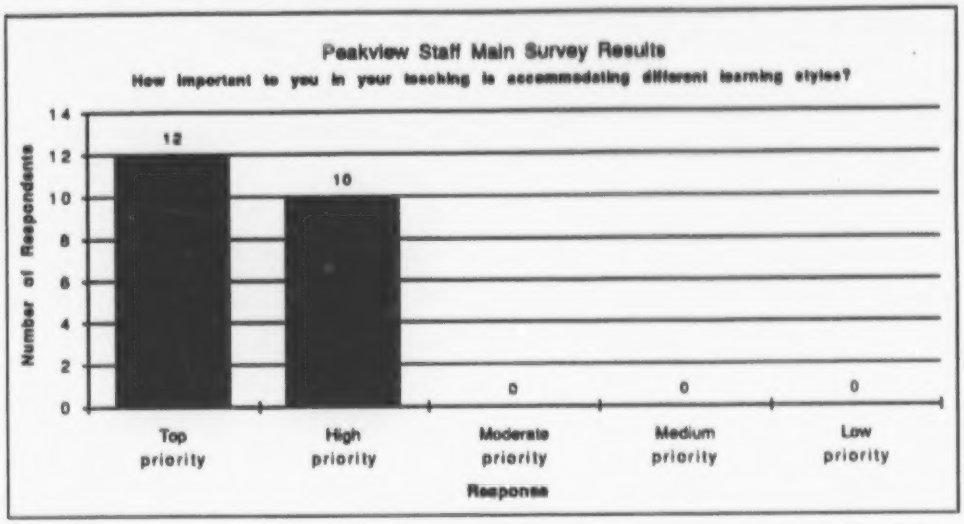
One teacher elaborated how technology-based activities differ from traditional activities:

> *There's a lot more open-ended time, free flow time where kids are doing a variety of activities, and one of those is computers.*

## Accommodation of Learning Styles

Students have different learning styles (e.g., visual versus verbal, serialist versus wholist, planful versus spontaneous). To determine the value teachers placed upon reaching children with different learning styles, teachers were asked, *How important to you in your teaching is accommodating different learning styles?* In response, all Peakview teachers responded to the goal as being "high" or "top" priority. Non-Peakview teachers' responses were not statistically different (Figure 30). Then, in response to the technology impact question on the same subject, 22 of 23 (96%) Peakview staff members agreed that technology helps them better accommodate differences in students' learning styles (Figure 31). Teachers across the four schools concurred, although Peakview showed sharply stronger effects ($\chi^2=19.74$, $p<.001$). Figure 32 shows that 13 of 23 Peakview teachers agree that using technology can help accommodate different learning styles. This was a higher mean than the three means of the comparison schools.


Staff Main Survey Results
How important to you in your teaching is accommodating different learning styles?
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Top priority
High priority
Moderate priority
Medium priority
Low priority
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
How important to you in your teaching is accommodating different learning styles?
Number of Respondents
14
12
10
8
6
4
2
0
12
10
0
0
0
Top priority
High priority
Moderate priority
Medium priority
Low priority
Response

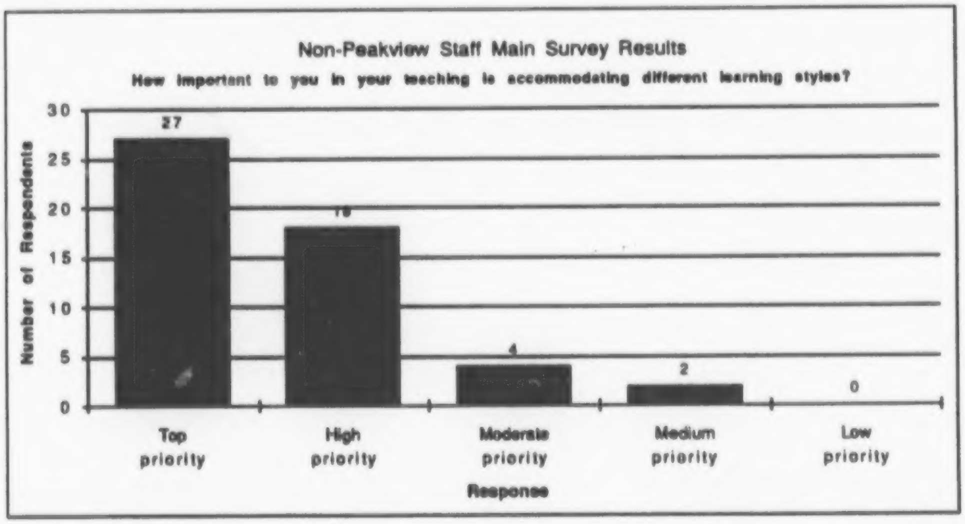
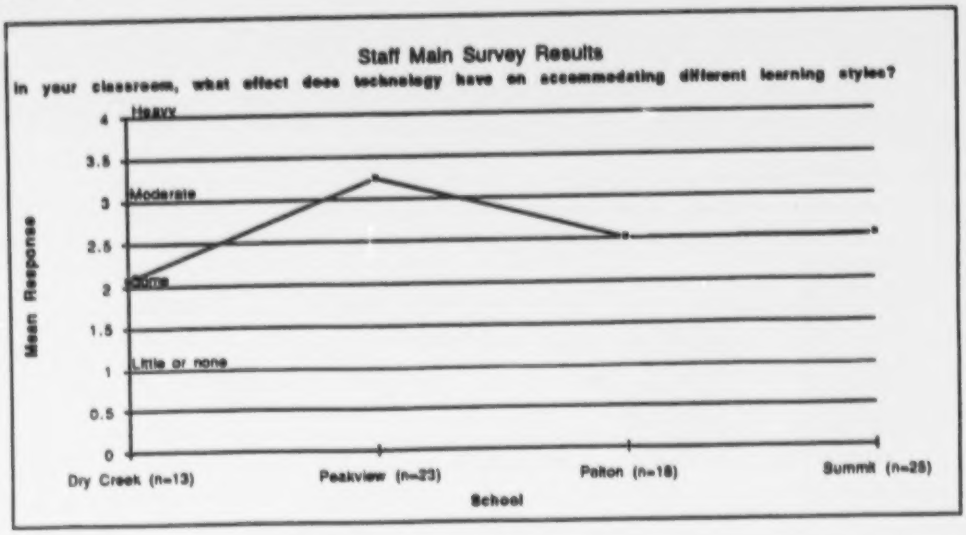
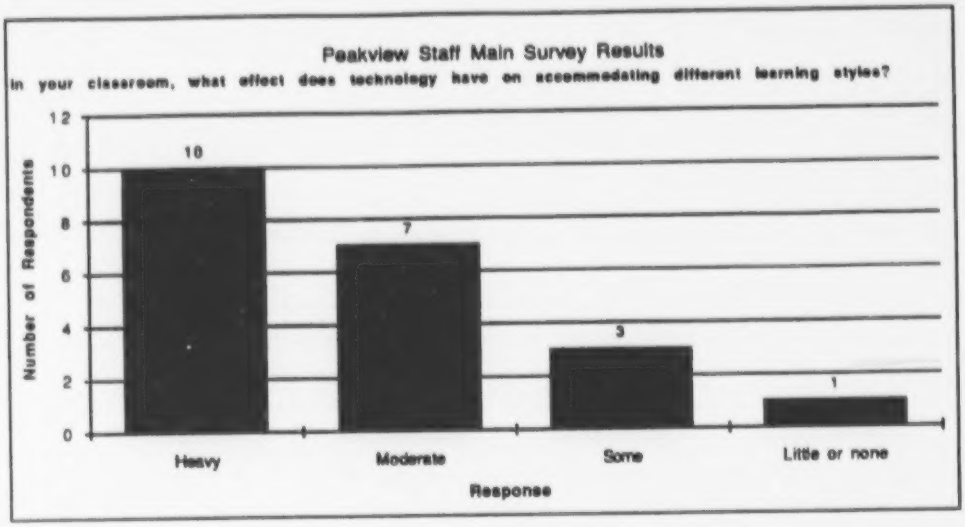

Non-Peakview Staff Main Survey Results
How important to you in your teaching is accommodating different learning styles?
Number of Respondents
30
25
20
15
10
5
0
27
18
4
2
0
Top priority
High priority
Moderate priority
Medium priority
Low priority
Response

Figure 30.


Staff Main Survey Results
In your classroom, what effect does technology have on accommodating different learning styles?
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
Heavy
Moderate
Some
Little or none
Dry Creek (n=13)
Peakview (n=23)
Palton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
In your classroom, what effect does technology have on accommodating different learning styles?
Number of Respondents
12
10
8
6
4
2
0
10
7
3
1
Heavy
Moderate
Some
Little or none
Response

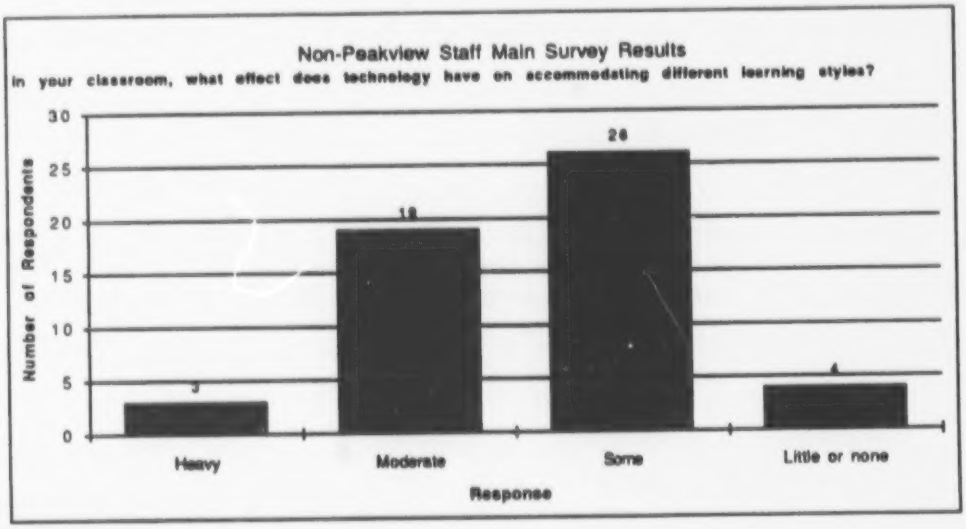

Non-Peakview Staff Main Survey Results
In your classroom, what effect does technology have on accommodating different learning styles?
Number of Respondents
30
25
20
15
10
5
0
3
19
26
4
Heavy
Moderate
Some
Little or none
Response

Figure 31.

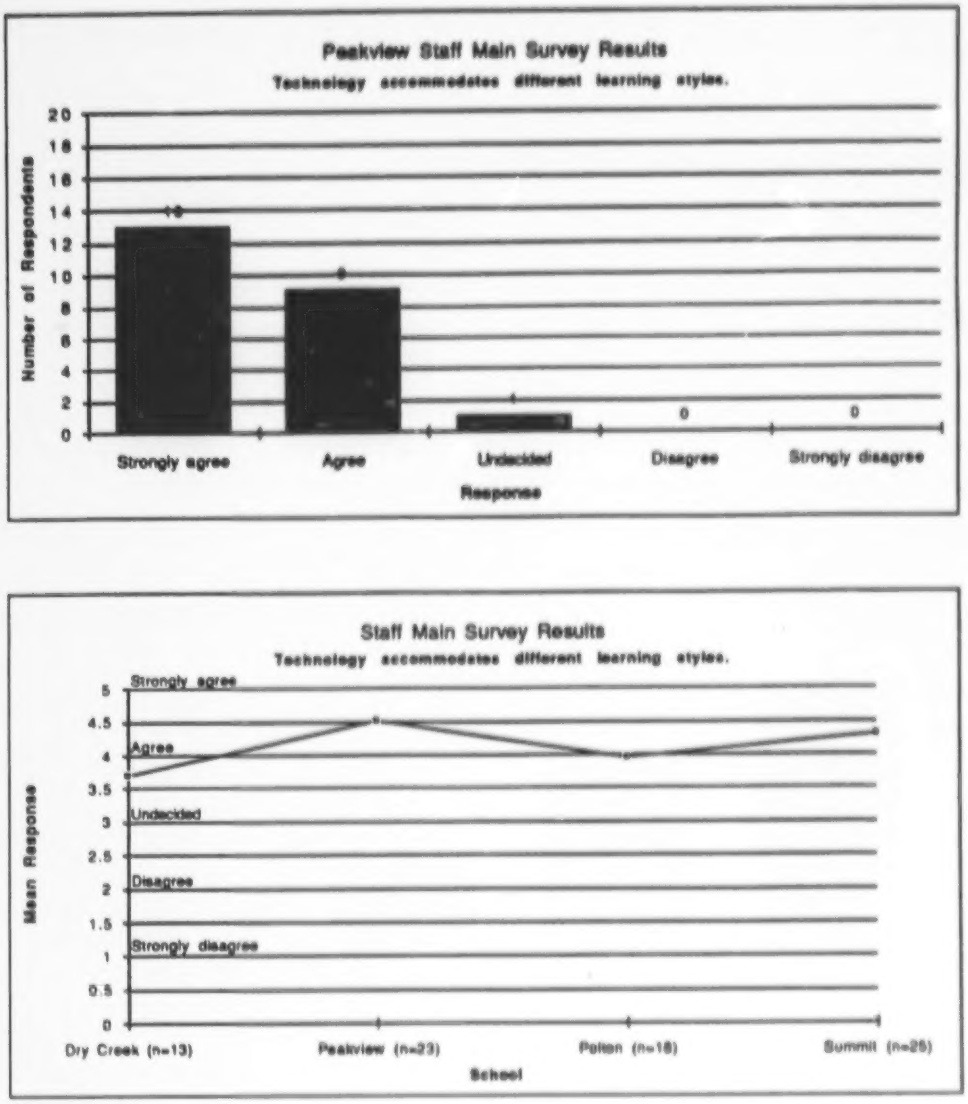


Figure 32.

## Students as Teachers

Most teachers place high priority on placing students in the "teacher" role (Figure 33). As shown in Figure 34, Peakview teachers judged the effect of technology on students assuming a teacher role was moderate to heavy, a larger effect than reported at other schools ($\chi^2$=15.14, p<.01).

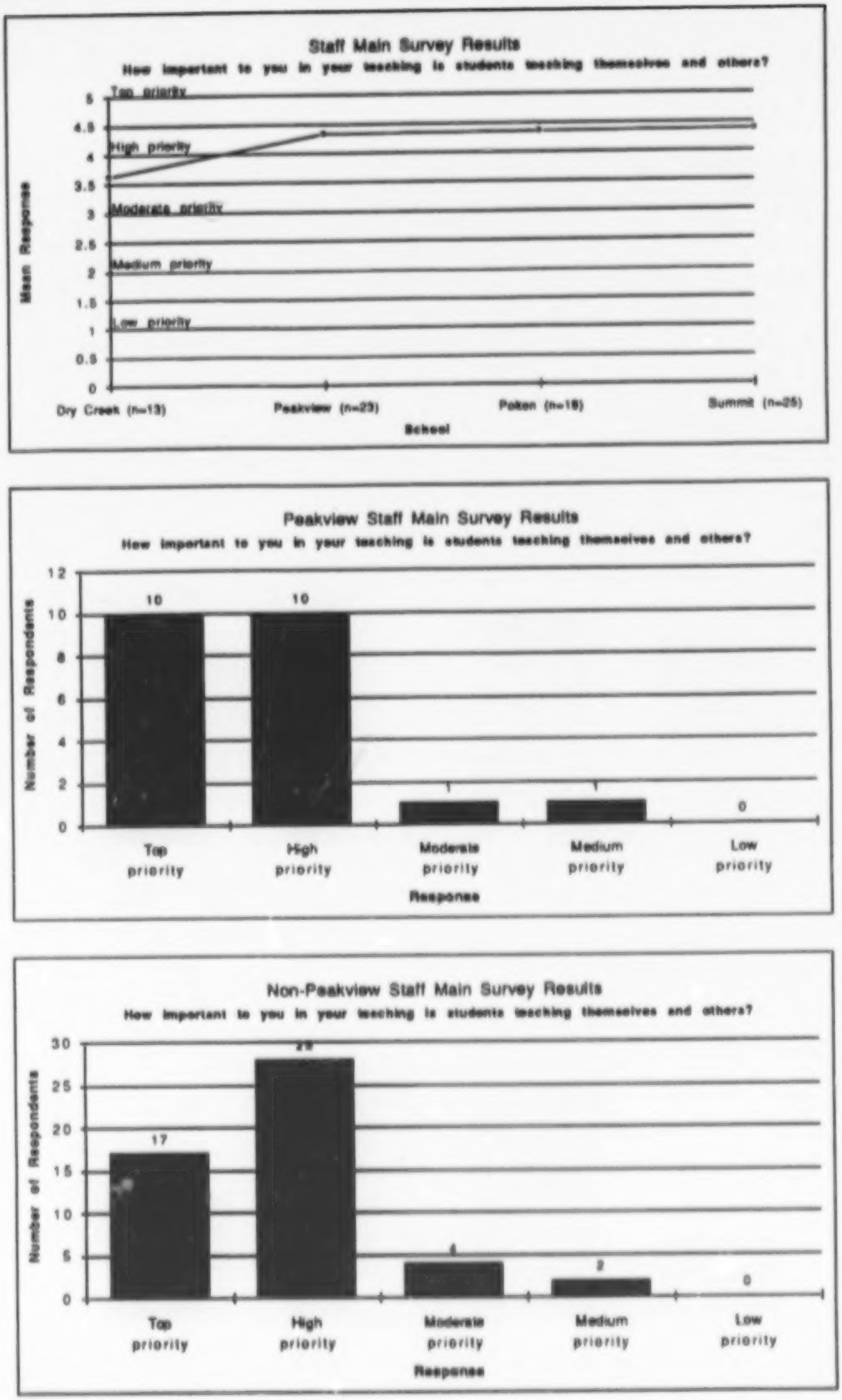


Figure 33.

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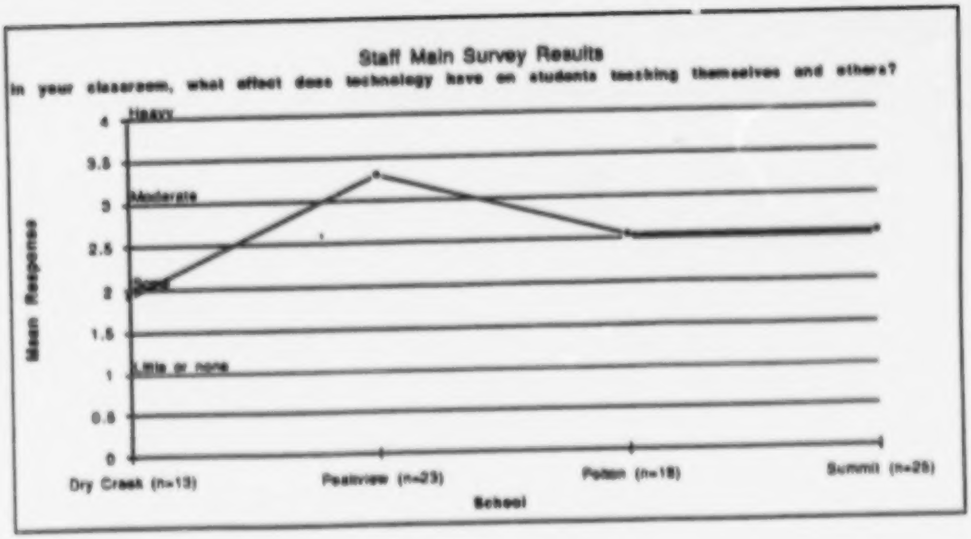
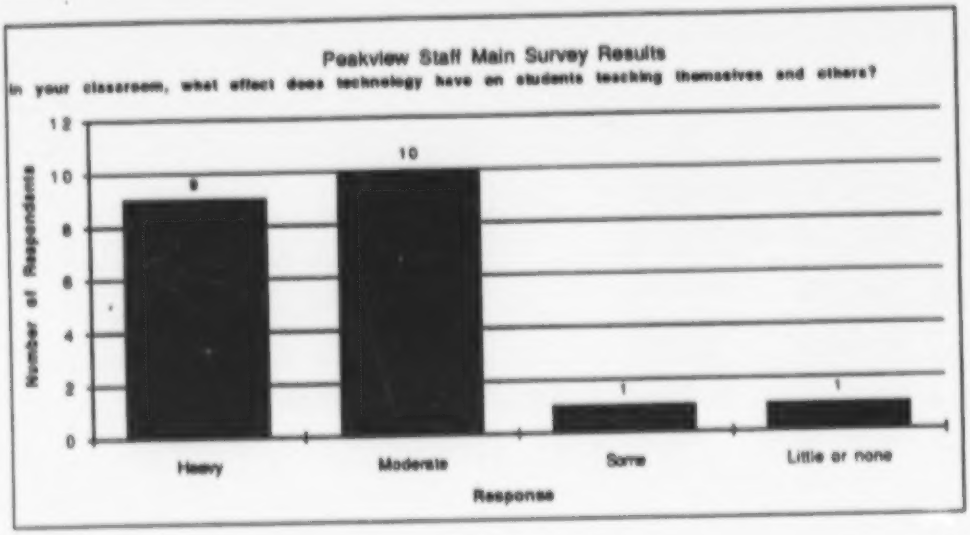

Staff Main Survey Results
In your classroom, what effect does technology have on students teaching themselves and others?
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
Heavy
Moderate
Some
Little or none
Dry Creek (n=13)
Peakview (n=23)
Patton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
In your classroom, what effect does technology have on students teaching themselves and others?
Number of Respondents
12
10
8
6
4
2
0
9
10
1
1
Heavy
Moderate
Some
Little or none
Response

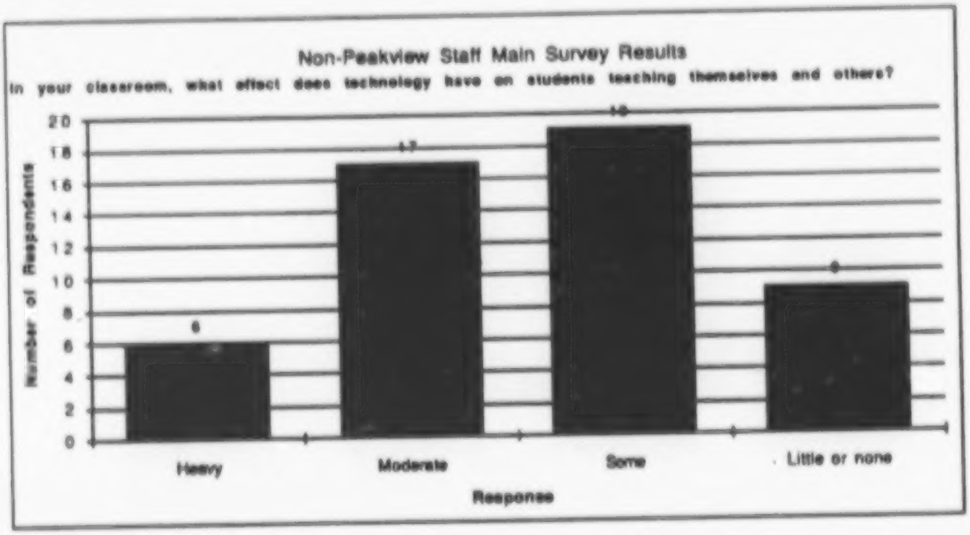

Non-Peakview Staff Main Survey Results
In your classroom, what effect does technology have on students teaching themselves and others?
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
6
17
19
9
Heavy
Moderate
Some
Little or none
Response

Figure 34.

Responses to a similar item are reported in Figure 35. This is a generic question on technology and students teaching each other, without reference to a specific context. Here again, Peakview teachers show stronger agreement with the statement than non-Peakview teachers ($\chi^2$=11.80, p<.01). Figure 36 reports on a similar item, with similar results.

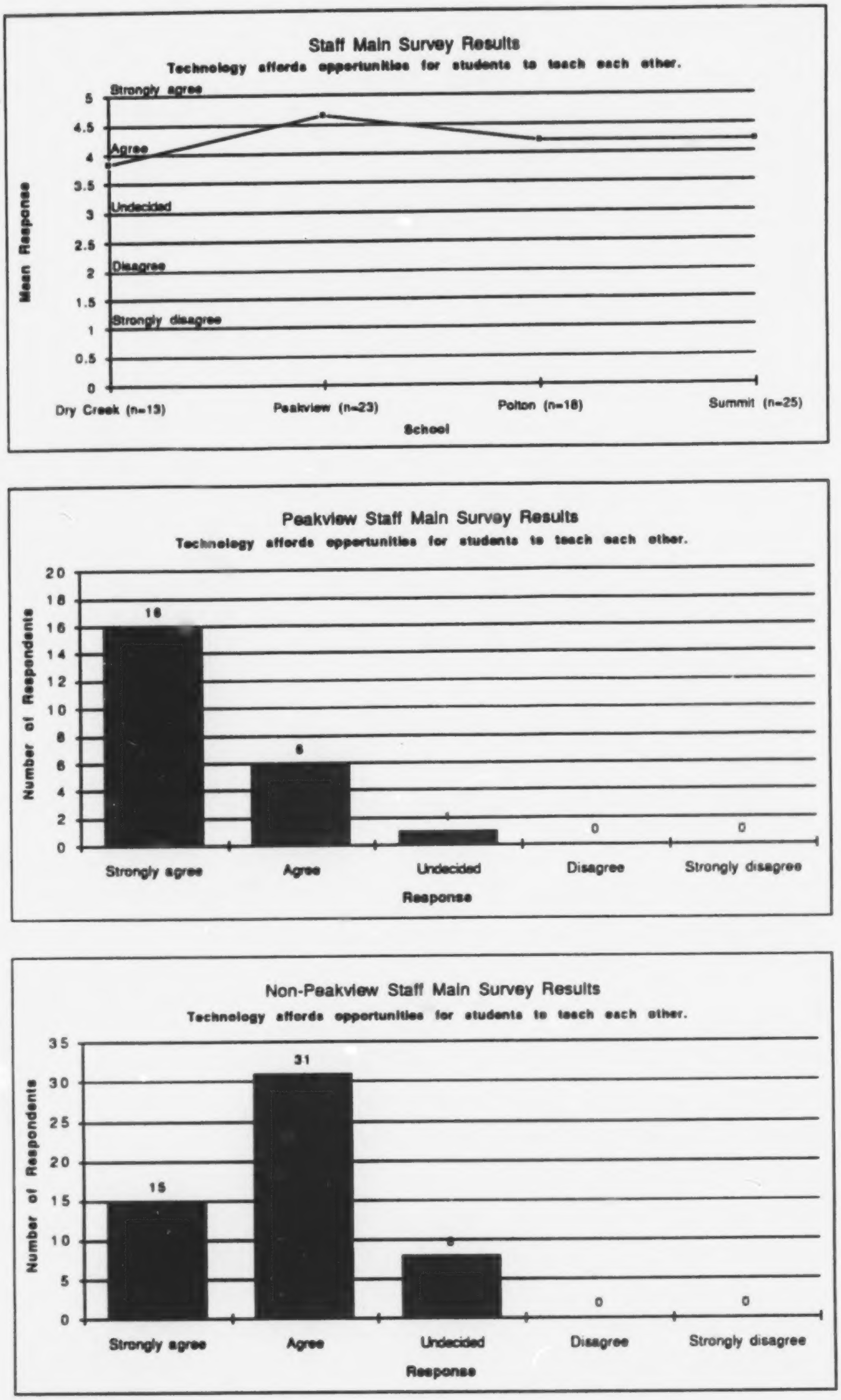

Staff Main Survey Results
Technology affords opportunities for students to teach each other.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Technology affords opportunities for students to teach each other.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
16
6
1
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response
Non-Peakview Staff Main Survey Results
Technology affords opportunities for students to teach each other.
Number of Respondents
35
30
25
20
15
10
5
0
15
31
8
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 35.

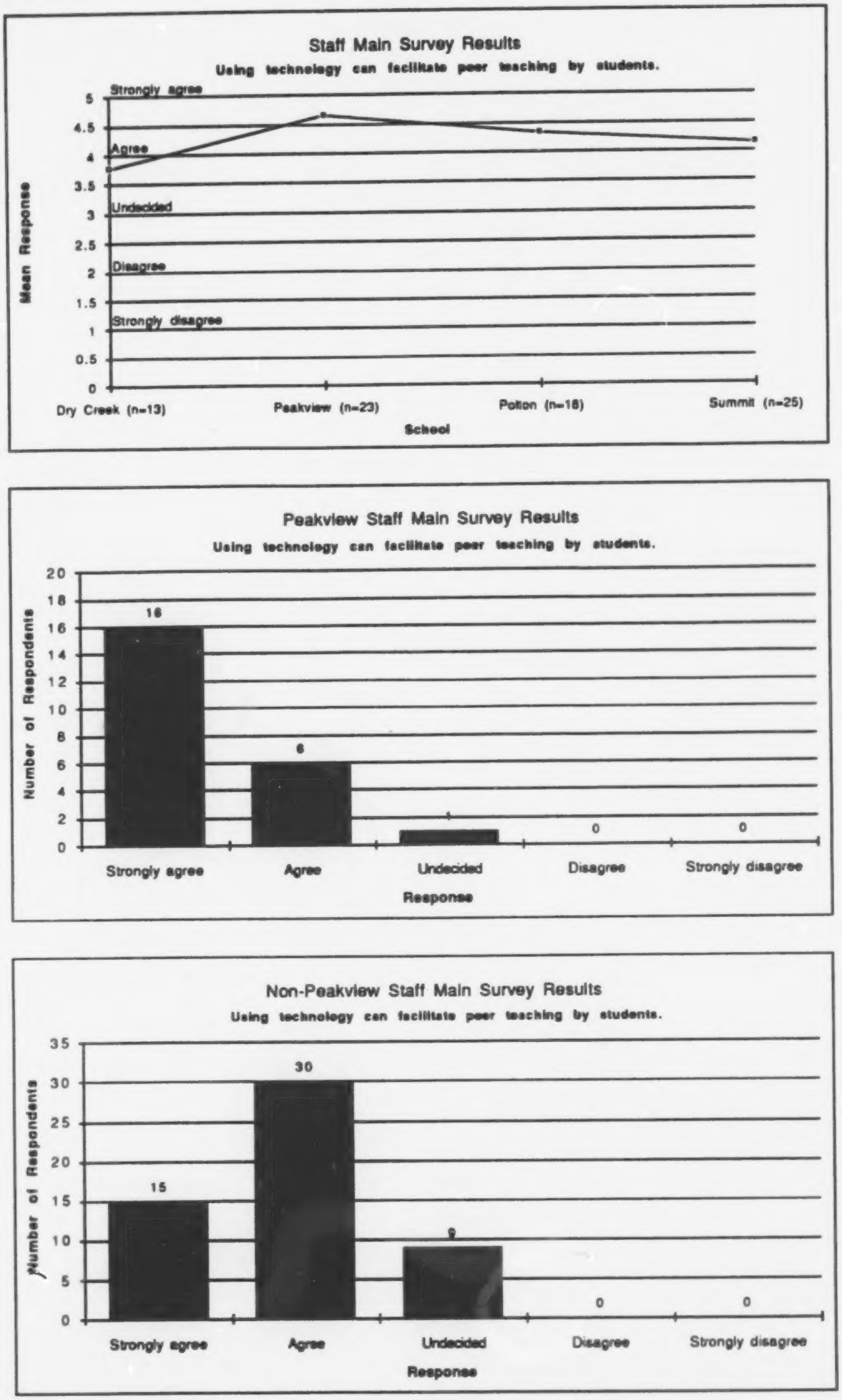

Staff Main Survey Results
Using technology can facilitate peer teaching by students.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Using technology can facilitate peer teaching by students.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
16
6
1
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response
Non-Peakview Staff Main Survey Results
Using technology can facilitate peer teaching by students.
Number of Respondents
35
30
25
20
15
10
5
0
15
30
9
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 36.

Several students reported times when they shared their knowledge with other students. This gave them a clear purpose for their knowledge and made them feel good about themselves:

> *Mm...If people need help like on HyperCard, like I know a lot about HyperCard...I'm pretty good with HyperCard...it's my favorite thing to do on computers, I help them by telling them how to use it if they don't know how. And if I don't know what they are asking the questions for, they can always ask the teacher or another student.* Jimmy
>
> *I feel smart when I help other people. It makes me feel good.* Billy
>
> *I went to a special class with one other person, I've been teaching people how to use HyperCard...I'm ahead of some people using it, but there's a lot of other people at my level.* Brandan
>
> *I like to help kids my own age, and younger kids too, get programs on the computer.* Sammie
>
> *I [have] done a lot. I've helped people with HyperCard, The Writing Center, and with the barcodes. I've helped with the laserdisc and with the scanners. I've helped with the Writing 2.0. It makes me feel good that I can help someone else. It made me feel like I was the teacher for a little while.* Charles

On occasion, students have opportunities to "teach the teacher" through technology. Children often feel at ease with technology and are able to share their knowledge with teachers and other adults. Teachers at all four schools report this state of affairs as being positive (see Figure 37). Very few teachers reported feeling threatened by students knowing more than they did about the technology.

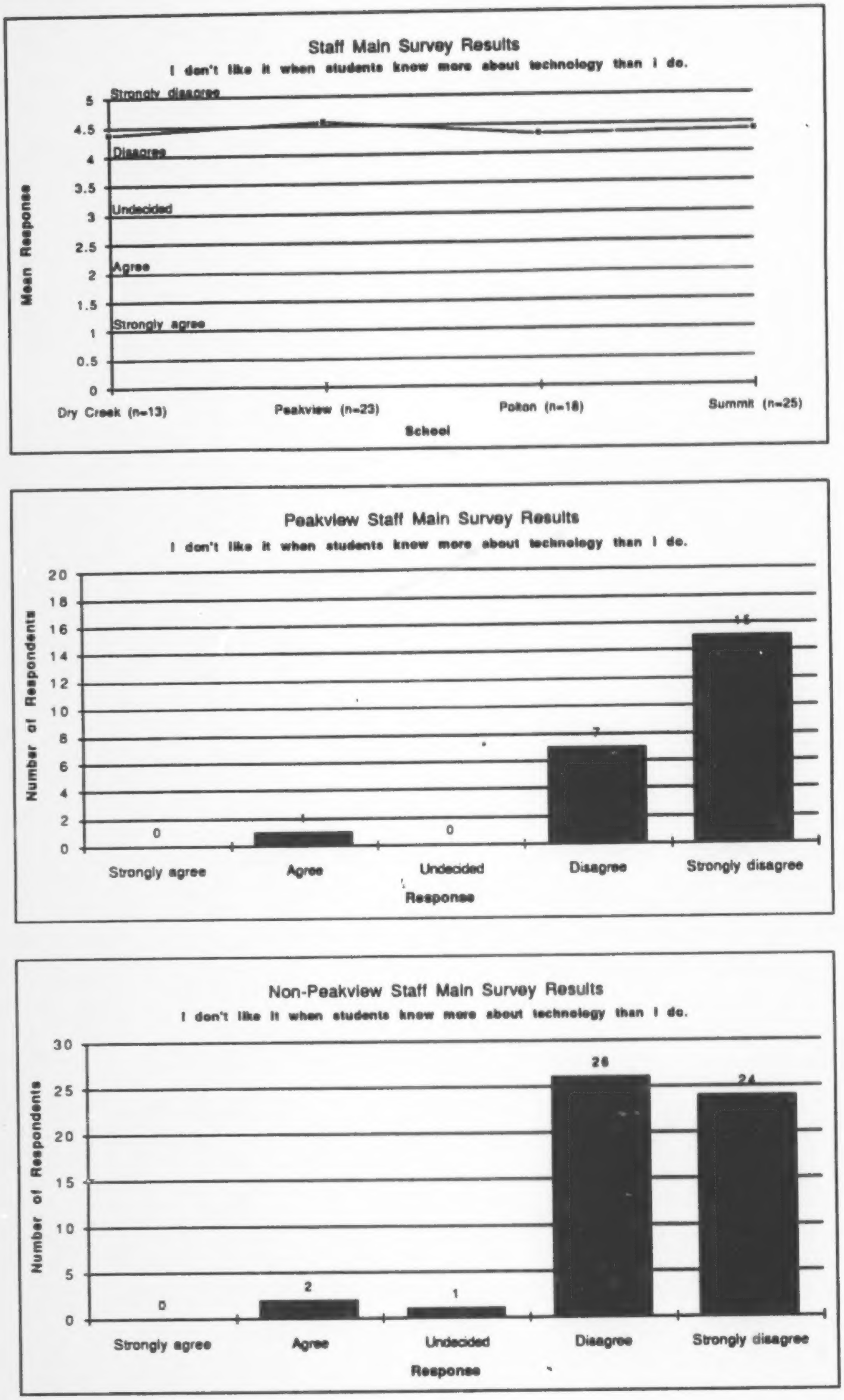

Staff Main Survey Results
I don't like it when students know more about technology than I do.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly disagree
Disagree
Undecided
Agree
Strongly agree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
I don't like it when students know more about technology than I do.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
0
1
0
7
15
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response
Non-Peakview Staff Main Survey Results
I don't like it when students know more about technology than I do.
Number of Respondents
30
25
20
15
10
5
0
0
2
1
26
24
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 37.

In the fall, one teacher described how he had become more willing to learn along with the children:

> *[I used to] ... feel I had to know more than kids.*
>
> *[Now I] ... am happy to learn steps on computer from kids (they're ahead of me.)*

Peakview teacher interviews included a question about students occasionally teaching the teacher. Here is a sample of responses:

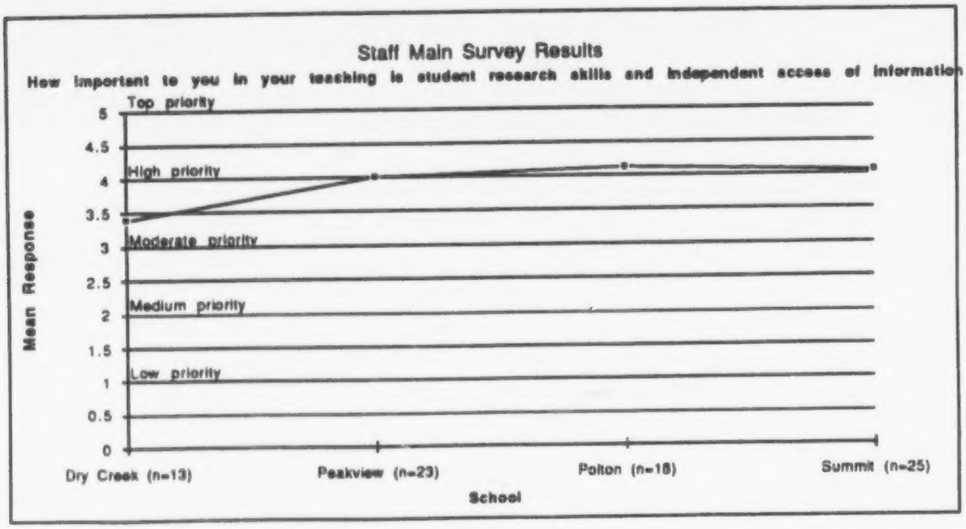
> *Technology has taught me and the children in my class to take a risk... We are learning together and I can't think of anything much better--children learning with adults and adults learning with children.* Charlotte, primary teacher
>
> *I don't know if I would ever choose to teach in a school with less technology. Not just because it's good for the kids, but it's fun to learn with the kids.* Adam, intermediate teacher
>
> *When they were teaching me, I felt great. I felt like I was learning something from them.* Mary, Kindergarten teacher
>
> *I like it a lot because it gives them a chance to see that I am a learner too. It's great to have kids that are authorities come and help somebody else.* Elizabeth, intermediate teacher
>
> *It has been a good experience for the kids to see me as a learner with them serving as the experts. I often find that they know more about using programs than I do. It has been great to have them be peer coaches in the use of technology. Once we teach a couple of kids how to do something, everyone, including the teacher can learn the technique!* Elizabeth, intermediate teacher

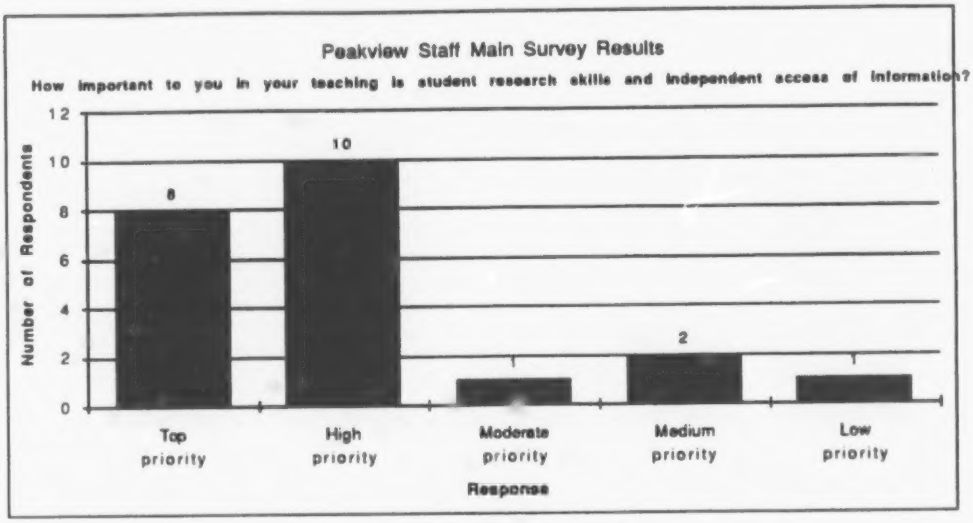
Some Peakview students reported times when they were able to help the teacher:

> *Once when this one teacher, our aide...she didn't know quite how to do something, boot the computer up, so I taught her how.* Marcus
>
> *The teacher didn't know how to get the bar across the top of the screen and he said thanks and everything. He gave me this card that said you can have 25 minutes on the computer after school. That was fun.* Curt

## Information Access and Research Activities

Teachers generally give high priority to student research skills and independent access of information (Figure 38). As shown in Figure 39, the effect that technology has on student research skills and independent access of information was rated as 'heavy' or 'moderate' by 17 of 20 Peakview teachers. This effect is stronger than that reported by non-Peakview teachers ($\chi^2=16.30$, $p<.01$).





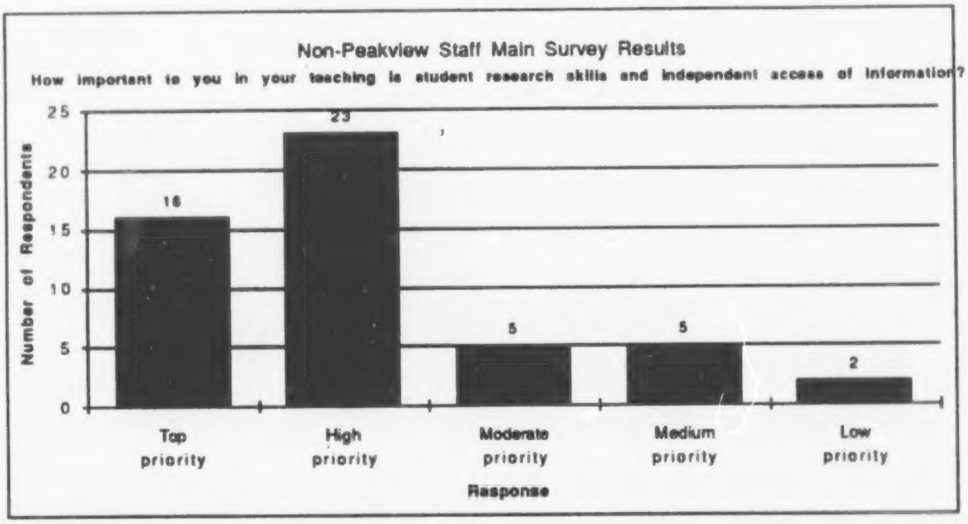


Figure 38.

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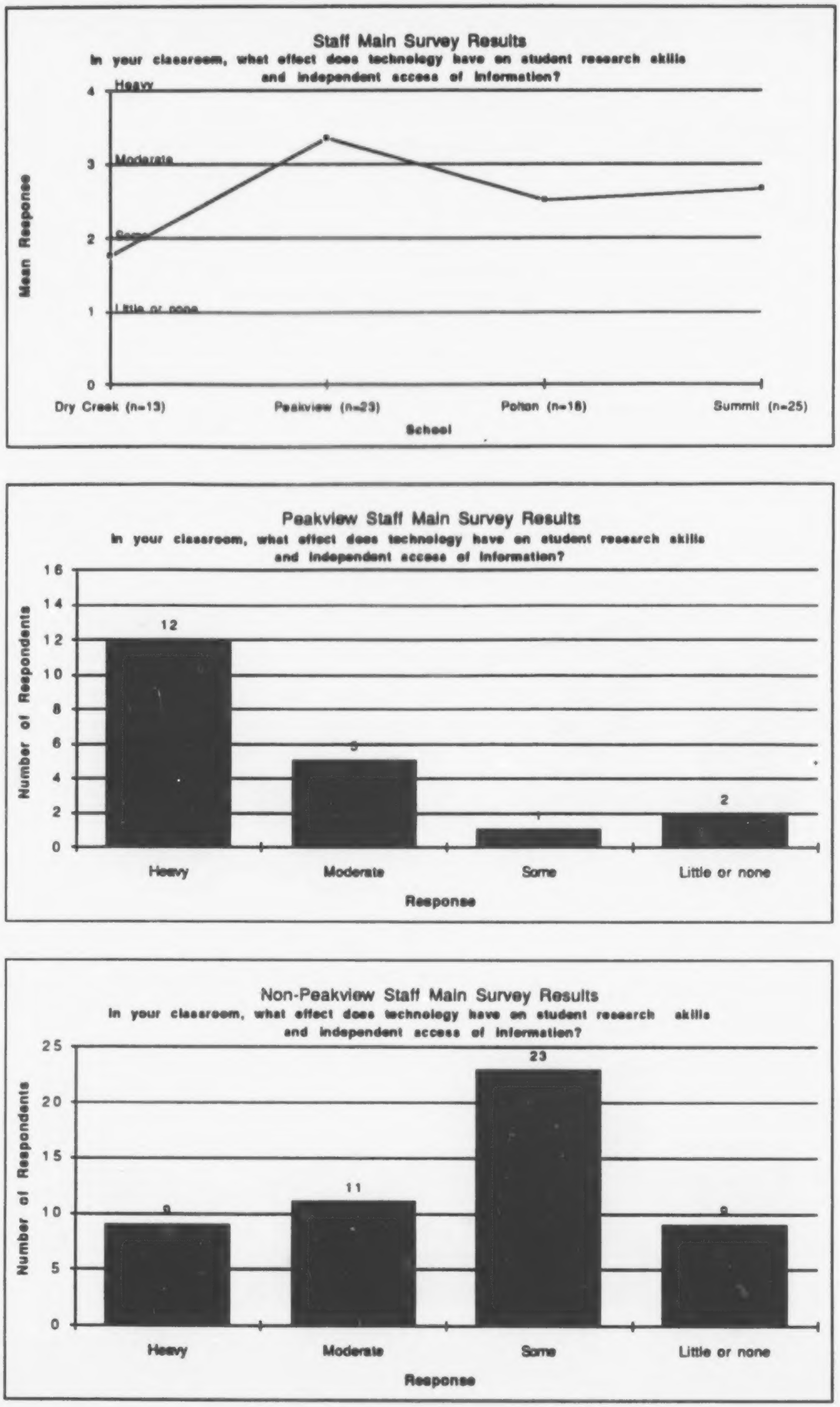

Staff Main Survey Results
In your classroom, what effect does technology have on student research skills and independent access of information?
Mean Response
4
3
2
1
0
Heavy
Moderate
Some
Little or none
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
In your classroom, what effect does technology have on student research skills and independent access of information?
Number of Respondents
16
14
12
10
8
6
4
2
0
12
5
1
2
Heavy
Moderate
Some
Little or none
Response
Non-Peakview Staff Main Survey Results
In your classroom, what effect does technology have on student research skills and independent access of information?
Number of Respondents
25
20
15
10
5
0
9
11
23
9
Heavy
Moderate
Some
Little or none
Response

Figure 39.

Peakview teachers were enthusiastic about using technology in support of student research:

> *It's not uncommon, if the kids are researching a topic, to say, "May I go to the media center to get this resource, to watch this laserdisc, etc." This is much different than the way it was in the past. The kids are taking this as an almost transparent resource...it's about as natural to go to use these resources as it is to use a textbook. Book reports have taken on an entire new meaning. It used to be that book reports used to be like pulling teeth. I'm not finding that to be the case now.* Michael, intermediate teacher

> *Kids seeing themselves as information seekers and users...using laserdiscs, GTV, Visual Almanac...turning around and creating products.* Adam, intermediate teacher

Students tended to agree about the value of the technology for finding information:

> *You can get information from all kinds of places.* Chad

> *I think I learn more from technology than from a book. You can go to different things that'll teach you stuff. You could go to a library and check out a book about cheetahs, but you can do it faster and you learn a lot more from a CD-ROM.* Marcus

> *The information it gives me. It's almost like a humungous book, except it's faster and easier to write it down.* Curt

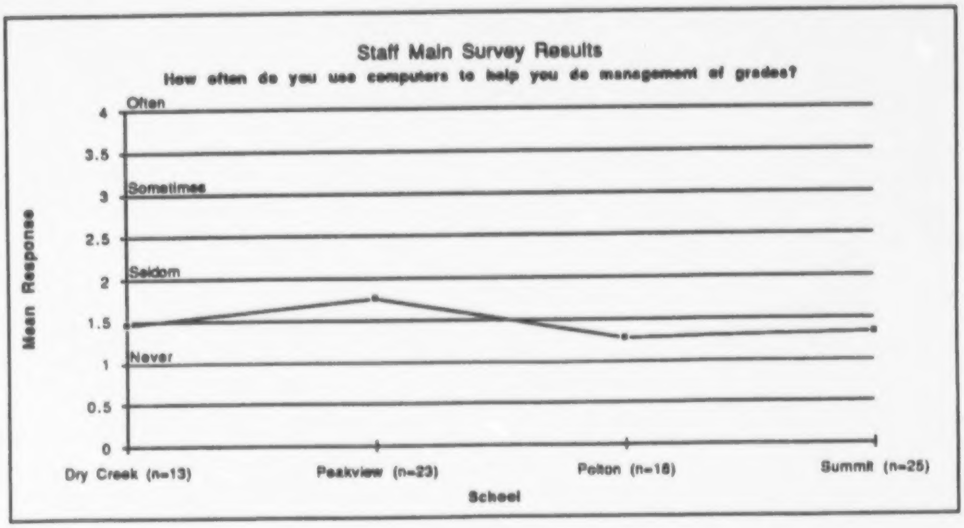
This section addressed the impact of technology on a variety of outcomes, including multiple learning goals, different learning styles, students as teachers, student access to information, and student research skills—all indicators of the degree to which technology empowers students to take an active role in directing their own learning. Each of these learning outcomes showed a similar pattern among respondents: Staff members at all schools indicated that these learning outcomes were high priorities in their teaching. Peakview staff members reported technology having a 'moderate' to 'heavy' effect on their ability to accomplish these learning outcomes. Consistent evidence from multiple sources indicates that technology can enhance student independence, voluntary peer coaching, and creative uses of information.

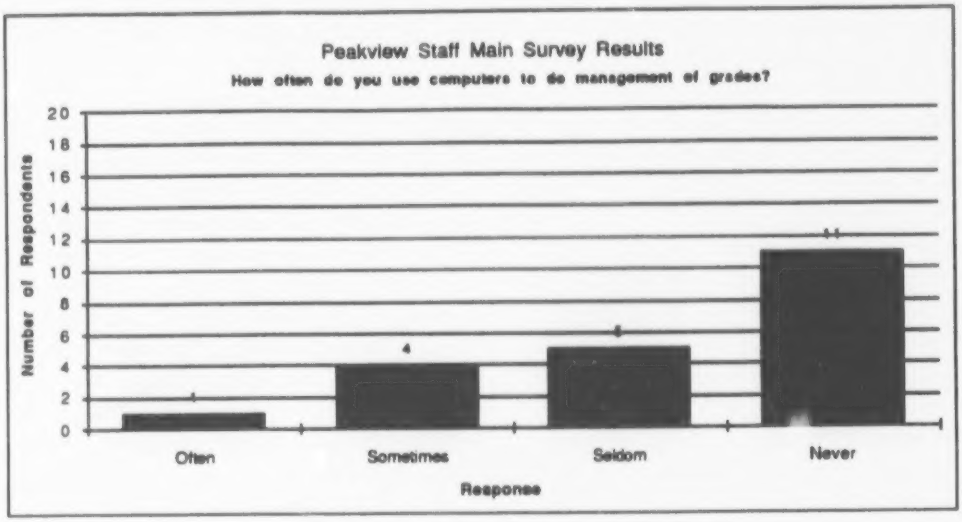
## Professional Uses of Technology

Teachers can make use of technology for a number of professional purposes. We survey a number of these uses in this section.

Computers are sometimes promoted for their gradekeeping capabilities. A number of grade manager software programs are available on the market. However, Figure 40 shows that relatively few teachers make use of technology for managing grades. This may be seen as an opportunity for future teacher growth. On the other hand, it is also possible that the grade management capabilities of computers are not needed by a number of teachers.

Figure 41 shows that a number of Peakview teachers have begun using technology for management of student evaluation portfolios. Peakview has begun a process of keeping electronic folders of student work. These folders can be used for evaluation purposes. Of course, the use of electronic portfolios requires a complete set of procedures, criteria, and policies.


Staff Main Survey Results
How often do you use computers to help you do management of grades?
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
Often
Sometimes
Seldom
Never
Dry Creek (n=13)
Peakview (n=23)
Polton (n=16)
Summit (n=25)
School


Peakview Staff Main Survey Results
How often do you use computers to do management of grades?
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
1
4
5
11
Often
Sometimes
Seldom
Never
Response

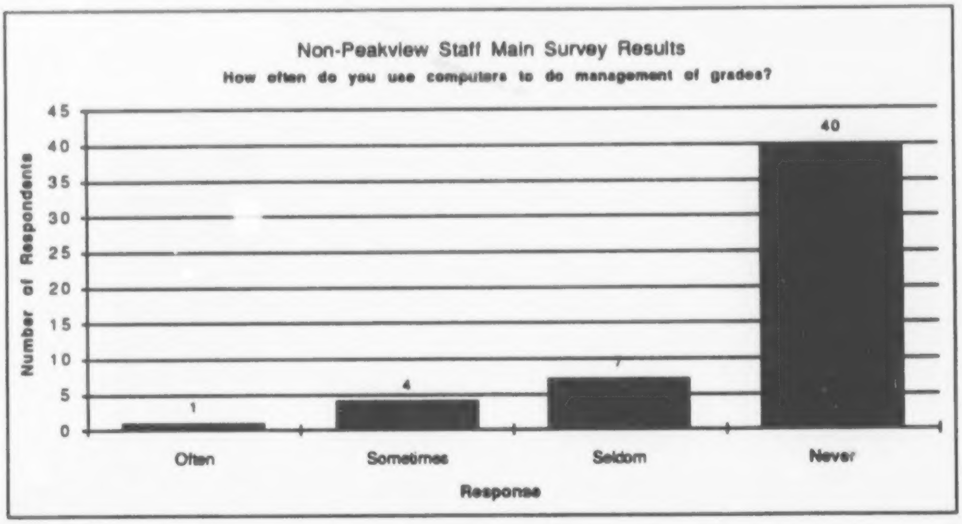

Non-Peakview Staff Main Survey Results
How often do you use computers to do management of grades?
Number of Respondents
45
40
35
30
25
20
15
10
5
0
1
4
7
40
Often
Sometimes
Seldom
Never
Response

Figure 40.

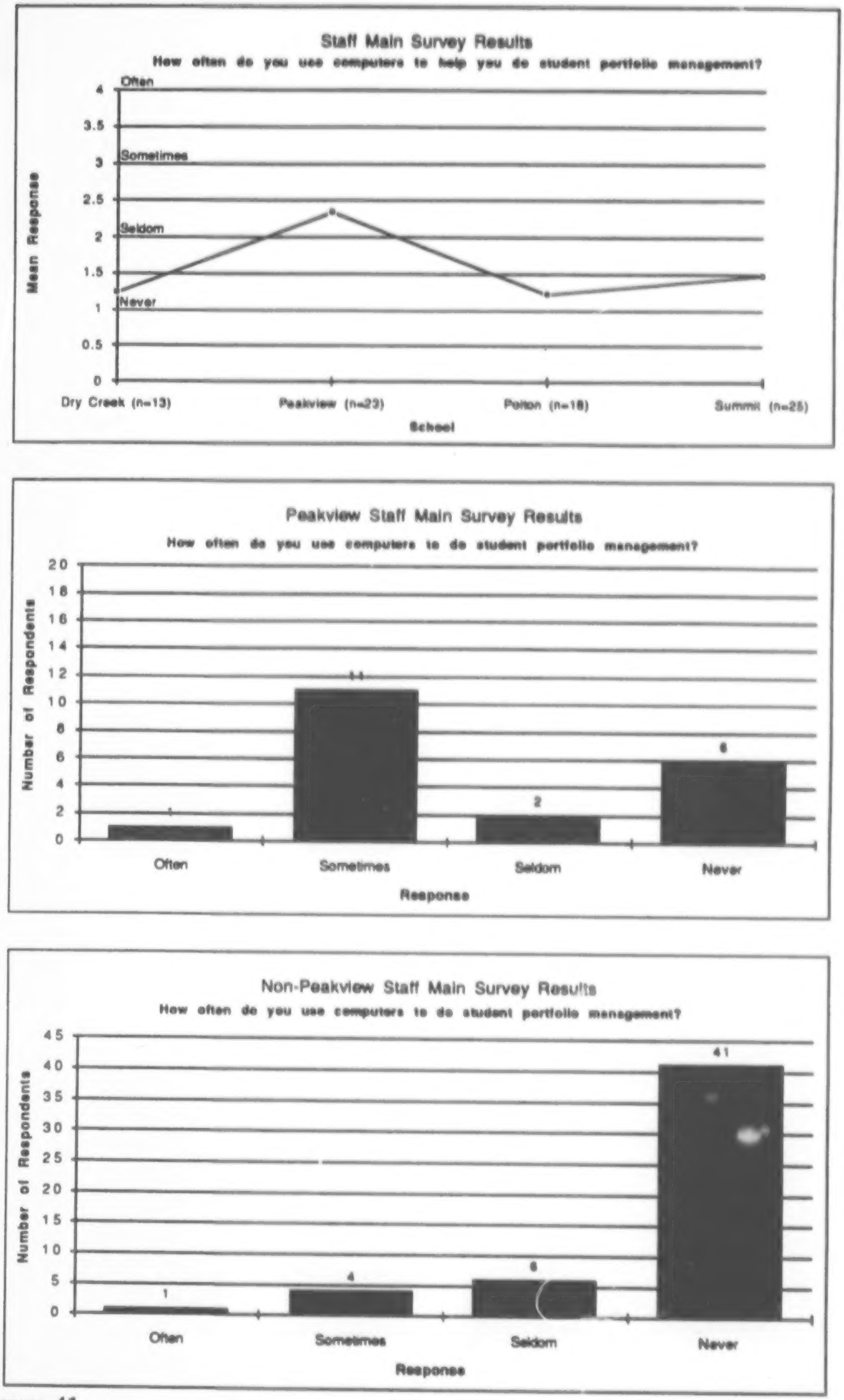

Staff Main Survey Results
How often do you use computers to help you do student portfolio management?
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
Often
Sometimes
Seldom
Never
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
How often do you use computers to do student portfolio management?
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
1
11
2
6
Often
Sometimes
Seldom
Never
Response
Non-Peakview Staff Main Survey Results
How often do you use computers to do student portfolio management?
Number of Respondents
45
40
35
30
25
20
15
10
5
0
1
4
6
41
Often
Sometimes
Seldom
Never
Response

Figure 41.

Teachers may also use computers to organize and manage the curriculum. Figure 42 reports very little use in this way across the four schools. This may reflect the fact that the schools do not use software with student recordkeeping components. On the other hand, the low response may be due to the vaguely worded question. Many teachers likely were confused about the precise meaning of 'curriculum management.'

We have some evidence that several Peakview teachers are busy at work in redesigning curriculum activities to take advantage of technology. For example:

> *I've changed the structure of my Writer's Workshop time to allow as many students as possible to use the computers. Even those who aren't yet writing in complete sentences can spell words which describe their pictures, and art programs such as KidPix have been obvious tools to use for this type of child.* Mary, Kindergarten teacher
>
> *Michael and I have essentially put together both of our science packets this year... electricity, static electricity, and simple machines. Technology combined with other resources. To be honest with you, computer access and word processing made it feasible.* Kate, intermediate teacher

Teachers were asked whether technology was used to facilitate in-school communications (Figure 43). At the present time, none of the schools has an electronic mail system in widespread use; Peakview teachers responded 'sometimes', whereas non-Peakview teachers responded 'never' most frequently. Because of the potential of electronic mail for communication within and between schools, we expect this area to see greater use in the future.

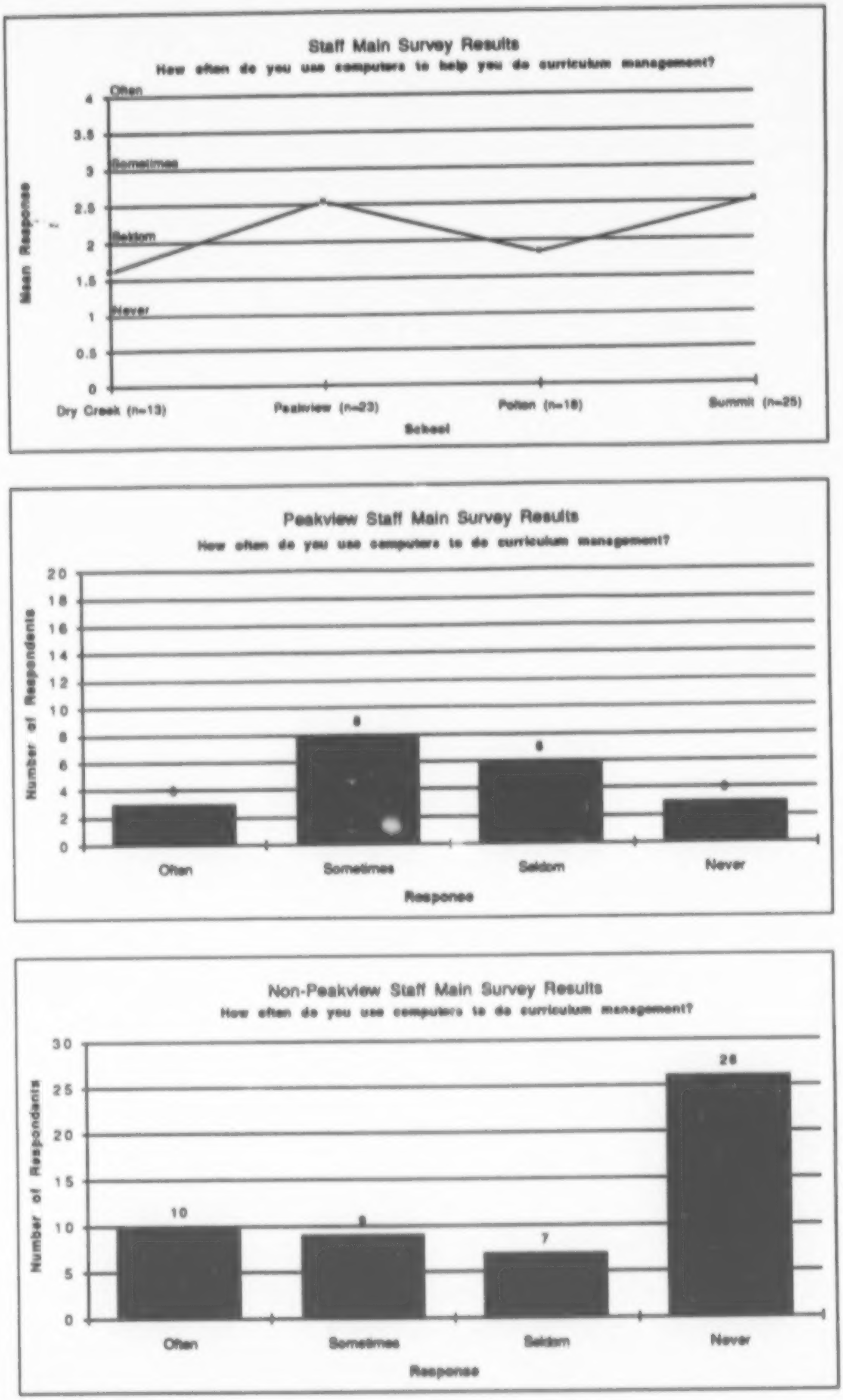

Staff Main Survey Results
How often do you use computers to help you do curriculum management?
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
Often
Sometimes
Seldom
Never
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
How often do you use computers to do curriculum management?
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
8
6
Often
Sometimes
Seldom
Never
Response
Non-Peakview Staff Main Survey Results
How often do you use computers to do curriculum management?
Number of Respondants
30
25
20
15
10
5
0
10
9
7
26
Often
Sometimes
Seldom
Never
Response

Figure 42.

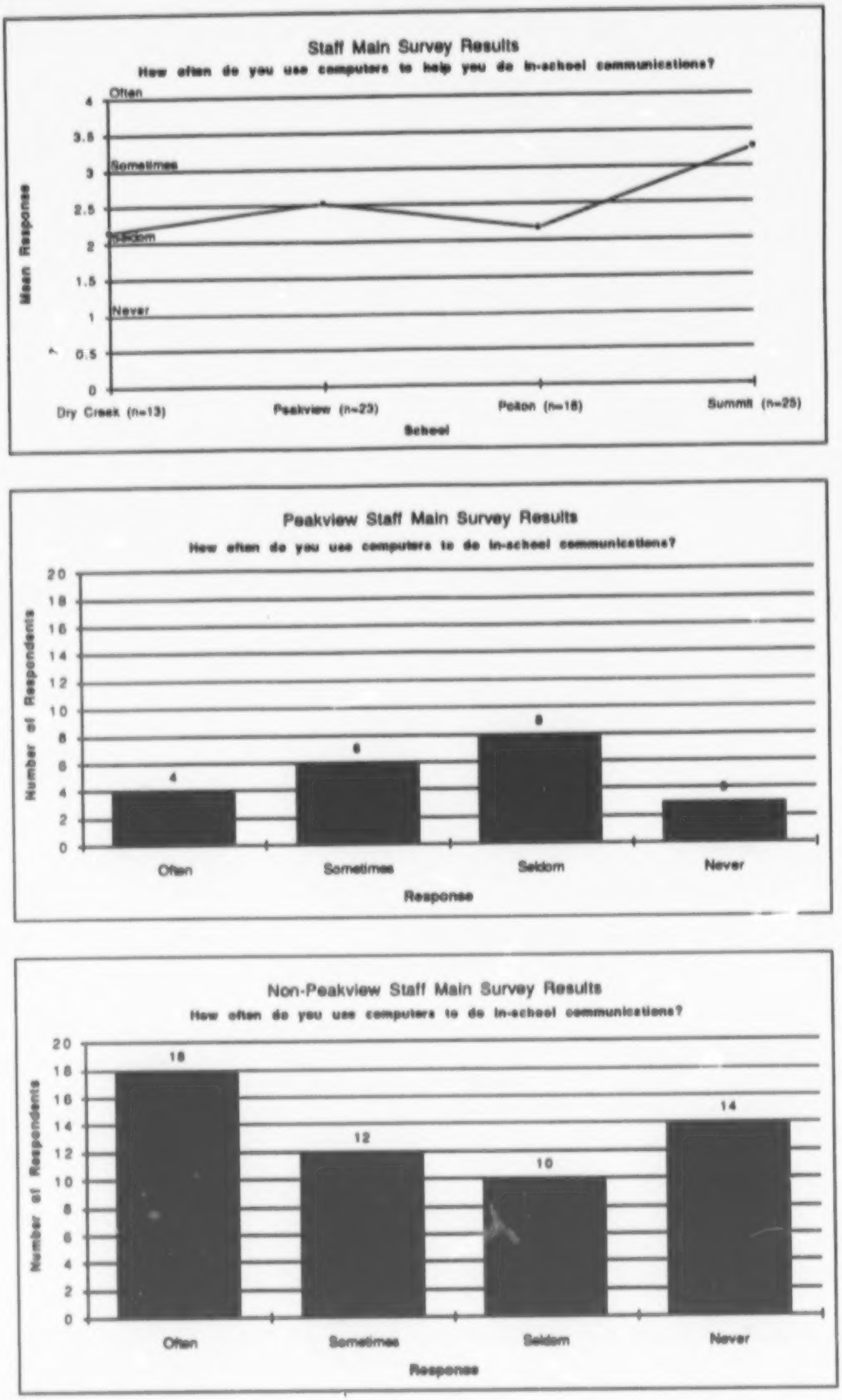

Staff Main Survey Results
How often do you use computers to help you do in-school communications?
Often
Sometimes
Seldom
Never
4
3.5
3
2.5
2
1.5
1
0.5
0
Mean Response
Dry Creek (n=13)
Peakview (n=23)
Pelton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
How often do you use computers to do in-school communications?
20
18
16
14
12
10
8
6
4
2
0
Number of Respondents
4
6
8
3
Often
Sometimes
Seldom
Never
Response
Non-Peakview Staff Main Survey Results
How often do you use computers to do in-school communications?
20
18
16
14
12
10
8
6
4
2
0
Number of Respondents
18
12
10
14
Often
Sometimes
Seldom
Never
Response

Figure 43.

# Implementation Factors

In this section, we address questions of how the technology was implemented within the school.

## Classrooms Versus Labs

The four schools in the study differed in the way they distributed their computers. Dry Creek and Peakview placed the computers within the classrooms, while Polton and Summit placed most of their computers in dedicated labs. On the main survey, Polton and Summit intermediate students reported going to the computer lab about once a week. Polton primary students reporting using the labs "about once a week", whereas Summit primary students reported using the labs "only once in awhile" (see Appendix D for graphs). We were interested in Peakview teachers' perspectives on the question of whether to place computers in classrooms.

Peakview teachers regard having the technology available and close to them as important. No Peakview teacher thought having computers in a lab was as good an idea as having them dispersed into the classrooms. All expressed a preference for having the technology in the classrooms. Teacher responded enthusiastically to classroom access to technology:

> *[I used to]... wonder what I would do with so many computers.*
>
> *[Now I] ... would like more!* August 1991
>
> *What has been most helpful to me is having the Mac available to me, in my room, all the time.* Nora, Kindergarten teacher
>
> *I still remember hearing the idea that a computer should be as casual a tool as a pencil. I fully embrace that vision and look to the day when every child has immediate access for journaling, calculating and creating...even doodling.* Lynn, primary teacher
>
> *Having the computers in the classroom provides a much more efficient way of utilizing computers as a means to facilitate learning. Eventually we will need to provide an environment which allows students constant accessibility to technology.* Matt, intermediate teacher
>
> *Having the computers in the classroom has been the key in helping me to experiment with the various programs. I strongly believe that I would not have taken such strides had they not been so easily available to me.* Kate, intermediate teacher
>
> *...the classroom-based technology structure is in constant use. Especially during the morning hours, there are few computer stations around the building that are sitting idle.* Jim, administrator
>
> *[I used to]... think that I could never use 5 computers in my class.*

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*[Now I]...* *want 25 (really 26, one for me).* August 1991.

Peakview teachers discussed the advantages of classrooms over labs:

> *Using computers in my classroom rather than in a computer lab has integrated them into our daily routine and made them another tool for learning along with papers, books, math manipulatives, maps and science materials.* Ginny, primary teacher

> *I think it's essential to have the computers in our classrooms instead of a lab. Even in kindergarten, we use them all the time, and we are constantly discovering new and different ways to use our technology to enhance every area of the curriculum.* Mary, Kindergarten teacher

> *[W]hen computers were in a computer lab, as much as I would have liked to use them in creating curriculum, keeping grades, writing letters to parents, creating new class lists for various reasons, etc., I just did not do so on a regular basis.* Kate, intermediate teacher

> *When I had a computer lab, students could only use computers during their assigned time slot, whether they had a real need for them at that time or not. Now whenever they have an idea or a project that would work well at the computer, it is available (usually).* Ginny, primary teacher

> *I think having the access to technology in the classroom... seeing that it's used all the time. The scheduling [in a lab] causes a diminishing of use. Here the technology is just used all the time.* Charlotte, primary teacher

> *I prefer having computers in the classroom over labs; but just as we are learning, and people come to observe us learning, each teacher does things differently.* Sandy, primary teacher

> *I'm hoping that we can serve that role, especially the idea of having computers in the classrooms instead of in the lab. I think that's made all the difference in the world. I have two kids in schools with labs, and I feel they're deprived.* Mary, Kindergarten teacher

> *First thing is having computers in the classroom. If I would have been coming through visiting, that's the first thing that stands out in my mind. In-classroom [computers are] better than a lab situation.* Nora, Kindergarten teacher

> *[I used to]...* *believe that the new technologies had little application in the elementary classroom...indeed, that elementary computer labs were an unnecessary complication in the lives of young children and their teachers.*

> *[Now I]...* *continue to hold the same view of labs—but my thinking on classroom-based technologies has turned 180 degrees. I am now a true believer.* August 1991

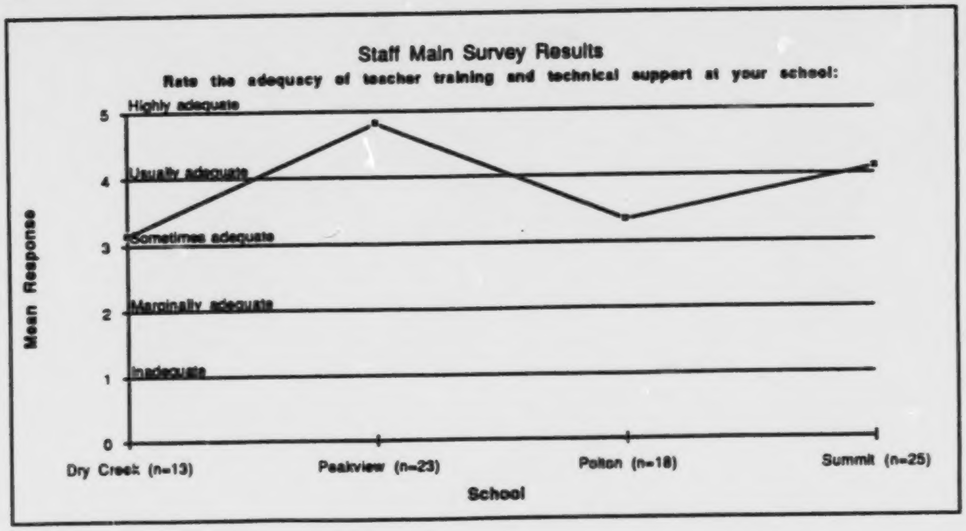
One Peakview student expressed much the same opinion (original spelling retained):

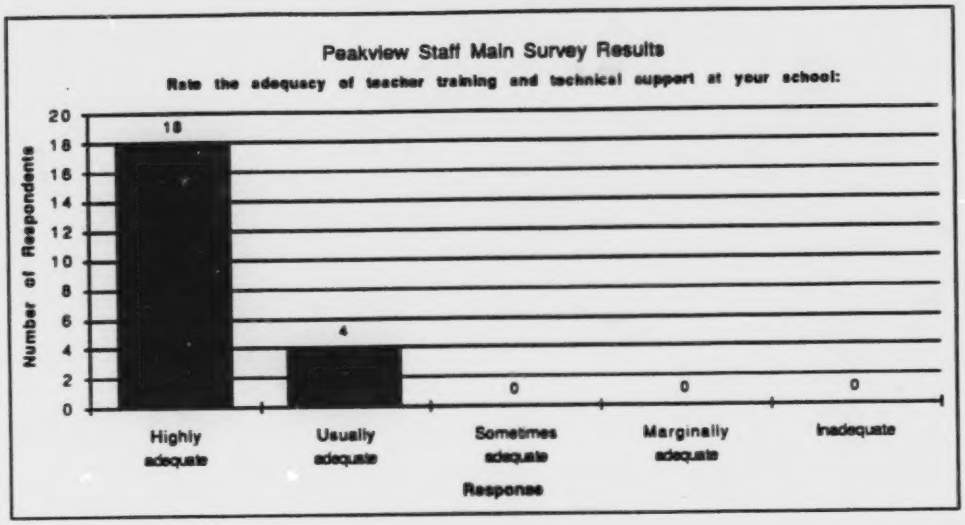
> *The technology her has changed so much of me into what I really won't to be. I can right any thing and put extra work. it used to be so different in Timerline. you could only go to the computer lab only when the class goes with you, that is like never.* Kristin

In summary, there was clear consensus among Peakview teachers that in-class access to technology holds important advantages to limited access to the technology through the labs. We do not, however, have a clear recommendation concerning the "threshold" number of computers that teachers need in a classroom to make integrated use feasible. At the least, we feel comfortable in concluding that the 4–5 computers available in each Peakview classroom was sufficient to allow their successful integration into the school day.

## Role of the Computer Coordinator

School level support for technology differed strongly among the schools (Figure 44). Most Peakview teachers judged the technical and support available within the school to be "highly adequate", while teachers from comparison schools judged their support to be from "sometimes adequate" to "usually adequate" ($\chi^2=24.19$, $p<.001$).





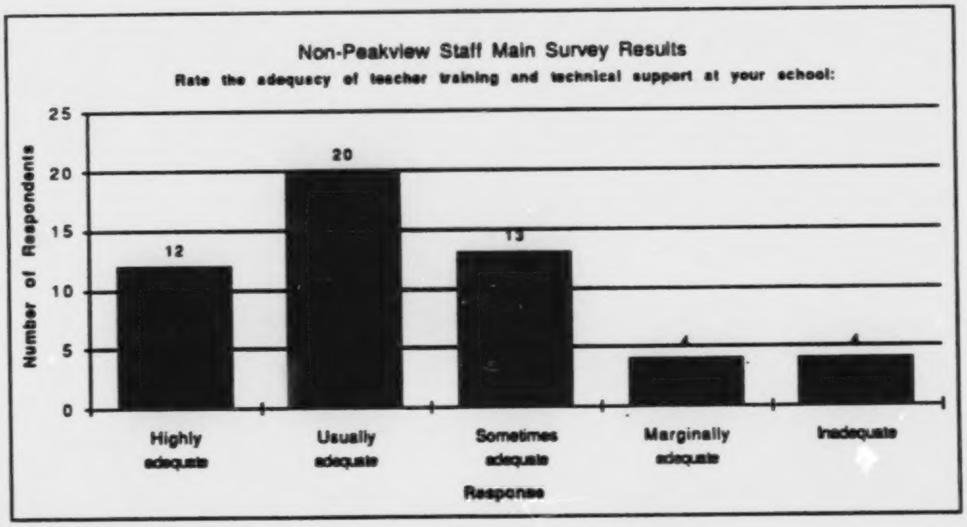


Figure 44.

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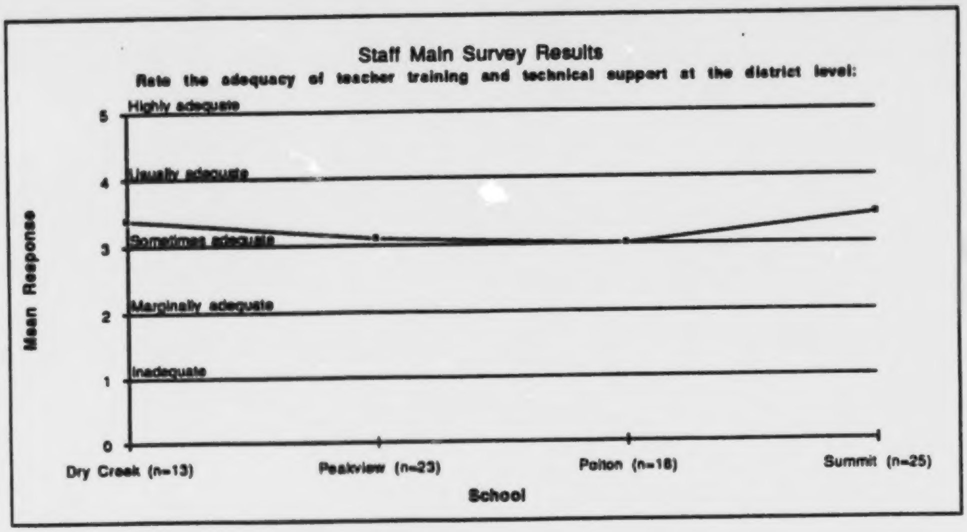
Karen Peterson is the full-time technology coordinator at Peakview Elementary. She has assisted in the school's technology planning, and presently works in a variety of capacities, including network management, hardware/software maintenance, and technology training and support. The coordinator's role is seen by many as very helpful to effective implementation of a curriculum such as Peakview's.

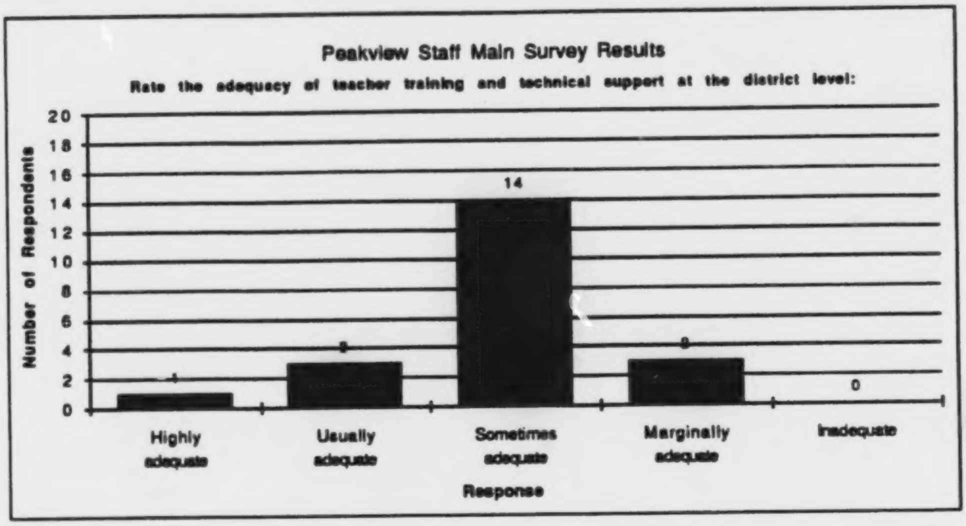
Several Peakview teachers commented on the role of the computer coordinator:

> *Karen Peterson's format with student-partners was a very successful one. The interaction was very productive, and the potential for others' benefit was doubled. My partner and I personally found it hard to keep up with the pace of this intense class, due to lack of free time for such.* Valerie
>
> *Karen Peterson, our computer specialist, has the teachers and students of Peakview ready to embark on a fantastic learning adventure. These kids will be prepared for and will welcome the technologically oriented future. Peakview is nurturing a new breed of exciting and empowered learners.* Michael, intermediate teacher
>
> *Having Karen give the classes & spend the time with us, on the computers, when we have questions! The hands-on approach is wonderful!! That's when we really learn the most!!* Nora, Kindergarten teacher
>
> *[Inservice] has been most effective when the kids gained training from Karen or other kids.* Lynn, primary teacher
>
> *It has been an extremely exciting year, and last year when we took all the technology courses with Karen I was motivated, it was fun.*
> *Karen's classes made a big difference.* Kate, intermediate teacher
>
> *I feel [that] what Karen has given is wonderful.* Charlotte, primary teacher
>
> *Karen taught two of the students how to use SuperPrint, then those students taught the rest of us, including me. That builds confidence in the children, they really have to know the program to do that.* Sandy, primary teacher
>
> *[I] Want [to take a] HyperCard class from Karen. Feeling left out.* Mary, Kindergarten teacher
>
> *This class that Karen's been teaching lately...a student is taking the class with us. She helps to disseminate the new information to the other kids. That's effective.* Jennifer, primary teacher
>
> *In order to do what we're doing at Peakview, you have to have a Karen Peterson, a person who has a vision and who is knowledgeable. That's one of the reasons why I don't get upset anymore, because Karen is always there to calm me down and support us.* Patricia, media specialist

## District Technical Support

District level support for technology was perceived across the four schools as "sometimes adequate" (Figure 45). No significant differences were found between Peakview and non-Peakview teachers.


Staff Main Survey Results
Rate the adequacy of teacher training and technical support at the district level:
Mean Response
5
4
3
2
1
0
Highly adequate
Usually adequate
Sometimes adequate
Marginally adequate
Inadequate
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
Rate the adequacy of teacher training and technical support at the district level:
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
1
3
14
3
0
Highly adequate
Usually adequate
Sometimes adequate
Marginally adequate
Inadequate
Response

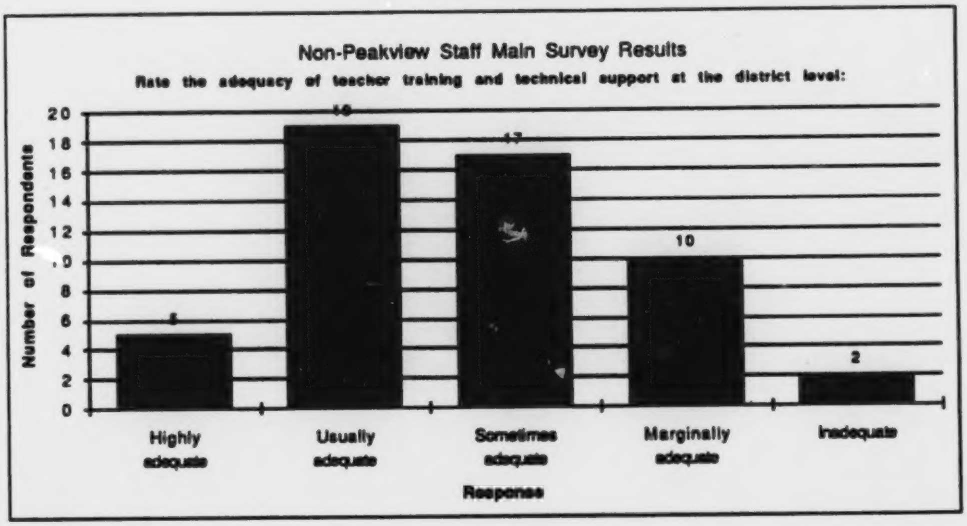

Non-Peakview Staff Main Survey Results
Rate the adequacy of teacher training and technical support at the district level:
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
5
19
17
10
2
Highly adequate
Usually adequate
Sometimes adequate
Marginally adequate
Inadequate
Response

Figure 45.

The questions concerning technical support and training are important to successful implementation for at least for two reasons:

1. Teachers who feel support in technology are less likely to feel threatened and pressured to work in areas where they lack competence; they are likely to develop more positive attitudes toward using the technology.

2. Teachers who receive adequate support and training are more likely to become proficient users of technology in the classroom. Without training and support, growth cannot be expected in this area.

## Taking Computers Home

Part of the teaching training plan for Peakview staff included the opportunity to take computers home for 6 weeks in the summer. Several teachers reported getting help from their own children in using the technology. The teachers at Peakview feel being able to take a computer home with them during the summer months was very important with regards to their own familiarity with the technology. The responses below to the helpfulness of this take-home time reflect its value to many teachers.

> *That was real important. I have two daughters at home, grade school and junior high level. Of course they, like a magnet, glommed onto the computer immediately...I could see their excitement and enthusiasm. That started to change my attitude toward the technology. One daughter [is] very right brained...enjoyed using Kidpix...another daughter [enjoyed] writing stories.* Jennifer, primary teacher

> *Crucial. I look at it as a break-in time. That first time, it was real intimidating. I was insecure and worried about it. Having the time to work at home with it helped me get over the initial intimidation.* Nora, Kindergarten teacher

> *That was crucial, [it was] absolutely crucial to have that at my house all summer. My own children actually kept spurring me on, showing me things...look at this...look at this. If I hadn't had it all summer, I would have been more timid when the school year approached.* Mary, Kindergarten teacher

> *It was very important. We had one Mac at the previous school. So I knew the basic operation of the Mac. That was important also.*
> *Having the summer to play around with it. I don't see it as an absolute prerequisite, but it sure helped.* Adam, intermediate teacher

> *For me, personally, I had purchased a Mac about 3 months earlier, but still, it was very very important. The enthusiasm people had about using the Mac LC's was incredible.* Matt, intermediate teacher

> *I'm glad I had it to take home.* Ginny, primary teacher

> *Being able to take the technology home and on vacation with me has been a dream come true. I have been able to do much work at home as a result. It has also helped to motivate me to have, more than any other year, do more of what the kids do before they do it.* Kate, intermediate teacher

## Additional Success Factors

Peakview teachers were surveyed in October concerning what factors most contributed to the successful implementation of technology at the school. Table 9 summarizes the 17 teachers' responses to these questions. Table 10 presents the raw data clustered into categories. The data presented in the tables generally confirm the findings reported above.

Teachers believe that having an adequate number of computers in the classroom is a key factor in the implementation plan. Several teachers remarked that the user-friendly interface and highly-quality educational software are important factors. Teachers also feel strongly that the computer coordinator, and the training and support she is able to provide, contribute to successful implementation.

Another commonly mentioned factor is the school-wide commitment to school reform and using technology in the classroom. Several teachers in interviews commented on the criticality of the reform-oriented values of the school toward successful use of technology. In other words, technology used to reinforce traditional methods of teaching and learning would not have the same dramatically positive impact on the school. As one teacher put it:

*[Technology provided a] terrific unifying type of a goal for us as a school to come together. I've seen that building-wide, a whole new thrust for us relating to technology. I've seen a tremendous burst of cooperative learning because of computers...*
Nora, Kindergarten teacher

Some helpful suggestions were offered for improving the implementation of technology at Peakview. Mini-courses for teachers and students together seem to have been well-received. One teacher suggested that inservice lessons be more informal and more frequent. Continued access to the computer coordinator was highly valued. Another teacher suggested training for students as they make the transition from primary to intermediate classes. Improvements in resource sharing and curriculum integration were also mentioned.

**Please list the key factors that you feel have made our technology program successful.**

| | |
|---|---|
| 12 | Computers in the classroom |
| 10 | Technology resource person |
| 10 | Software |
| 7 | Having enough computers |
| 7 | Teacher training and support |
| 6 | Hardware |
| 5 | Access to technology |
| 5 | Shared commitment to technology |
| 3 | Teachers and kids learning together |
| 3 | Student training |
| 3 | Curriculum integration |
| 2 | Sharing resources |
| 1 | Up-to-date technology |

**Do you have any suggestions that could help make it better?**

| | |
|---|---|
| 11 | More technology |
| 7 | Teacher training suggestions |
| 6 | Maintenance and planning |
| 2 | Technology resource person |
| 2 | Hardware suggestions |
| 1 | Documentation |
| 1 | Resource sharing |
| 1 | Curriculum integration |

Table 9. *Summary of Peakview teachers' perceptions of success factors.*

**1. Please list the key factors that you feel have made our technology program successful.**

**Computers in the classroom**
- —having computers in the classroom [K–2]
- —having computers in the classroom instead of a lab [K–2]
- —having the computers in our classroom. [K–2]
- —computers in classroom, so easy for kids to use [K–2]
- —in classrooms [Intermediate]
- —computers in the classroom [Intermediate]
- —computers in room [Intermediate]
- —in class—computers and instructors [Support Staff]
- —classroom computer setting as opposed to lab setting [Support Staff]

**Technology resource person**
- —Karen Peterson/resource person, suggesting ideas for use, training teachers through classes, etc. [K–2]
- —having a technology specialist who is supportive [K–2]
- —Karen Peterson's strong commitment [Intermediate]
- —having [Karen] as a resource for not only kids but staff [Intermediate]
- —having Karen as a school resource person [Intermediate]
- —having Karen free to assist classroom teachers and students [Intermediate]
- —Karen—unending efforts—full-time computer person [Support Staff]
- —Karen P. facilitating our growth as adults and kids [Support Staff]
- —designated technology person—key [Support Staff]

**Software**
- —great programs [K–2]
- —the programs are fun but educational at the same time [K–2]
- —creative, user friendly software (Windows, etc.) & hardware (Mac) [K–2]
- —variety of software appears to capture kids' interest [K–2]
- —the ease of Apple environment for students to move around in [Intermediate]
- —the wide variety of interesting software [Intermediate]
- —variety of programs available to kids [Support Staff]
- —exciting software [Support Staff]
- —the HyperCard decision [Support Staff]

**Having enough computers**
- —multiple computers in every classroom [K–2]
- —the numbers of computers [Intermediate]
- —number of computers and availability in classrooms [Support Staff]

**Teacher training and support**
- —teaching the teachers how to use the computers. [K–2]
- —early (before school even started...) in-services on software, using the Macs, etc. [K–2]
- —staff and kid training time [K–2]
- —staff development [Intermediate]
- —technology assistance in classroom [Intermediate]

**Hardware**
- —Macs are great – network is fab. [K–2]
- —classroom-based, networked structure [Support Staff]

Table 10. *Peakview teacher responses to implementation questions.*

**Access to technology**
- —computers are so accessible to the children [K–2]
- —easily accessible to all kids [K–2]
- —easy access to laser disc sounds [Intermediate]
- —having a variety of multi-media available to kids -- showing the connections to real life [Intermediate]
- —handy access to classroom tech. [Intermediate]

**Shared commitment to technology**
- —staff willingness to try without being experts and overcoming frustrations—still willing to utilize even though slow, bad printers, etc. [Intermediate]
- —our commitment [Intermediate]
- —the common goal of tech. [Intermediate]
- —teacher attitude toward tech. [Intermediate]
- —teachers' willingness to learn & utilize [Support Staff]

**Teachers and kids learning together**
- —the multi-age groupings, when teaching each other. (The kids interacting.) [K–2]
- —teachers seen as fellow learners with students [Intermediate]
- —students helping other students & becoming the experts [Support Staff]

**Student training**
- —computer classes—for kids and adults [Intermediate]
- —in services for kids/adults [Support Staff]

**Curriculum integration**
- —it can be incorporated into the unit we are studying [K–2]
- —the way tech fits into the curriculum & individualized instruction can happen at same time as the teacher is working with other groups [Support Staff]
- —use in projects—writing on the computer, interactive capability with reports [Support Staff]

**Sharing resources**
- —being able to wrap computers around our "flexible" walls & having "flexible" team-mates so we can access even more computers. [K–2]
- —having computers in classroom & set up in each area as they are [Intermediate]

**Up-to-date technology**
- —up to date technology—introd. of new programs [Support Staff]

Table 10 continued. *Peakview teacher responses to implementation questions.*

**2. Do you have any suggestions that could help make it better?**

**More technology**
—computers are constantly used, even with kids waiting for their turn, therefore more computers would assist more kids. Computers are the first choice. [K–2]
—more computers [K–2]
—more computers! [K–2]
—more computers [K–2]
—more computers [Intermediate]
—more, more, more! [Intermediate]
—More [Intermediate]

**Teacher training suggestions**
—Instead of this year's in services being on a formal, paid, for-credit basis, have occasional more informal in services for everyone who's interested..., i.e., today we're going to talk about Kidworks, sign up if you're interested [K–2]
—more students in classes with teachers [Intermediate]
—smaller class size—12 or so [Intermediate]
—could I learn all I need to know in my sleep hours—neural implants...something! [K–2]

**Maintenance and planning**
—more money to stay up with the new and continue to add computers as teachers and students are added [Support Staff]
—could we get all our hardware up and functioning? [K–2]
—transitional training for primary kids to intermediate (between the years). Awesome idea! [Intermediate]
—working machines [Support Staff]
—fewer hardware/network changes [Support Staff]
—maintenance of machines—e.g., printers [Support Staff]

**Technology resource person**
—more time with Karen, to learn more! (Us and the kids!) [K–2]
—continued support for technology person [Intermediate]

**Hardware suggestions**
—laptops for students [Intermediate]
—CD-ROMs for each classroom [Intermediate]

**Documentation**
—Users manual [K–2]

**Resource sharing**
—More computers in each room or better ways to manage time on computers not being used by other teams during specials (?), etc. [Intermediate]

**Curriculum integration**
—all instructional areas need to be included if only on limited basis—i.e., in music computer instruction in specific area of interest. [Support Staff]

Table 10 continued. *Peakview teacher responses to implementation questions.*

# Teacher Attitudes

Peakview teachers report that their attitudes toward technology in the classroom have changed substantially over the past year (Figure 46). Teachers at Polton and Summit also report attitude changes.

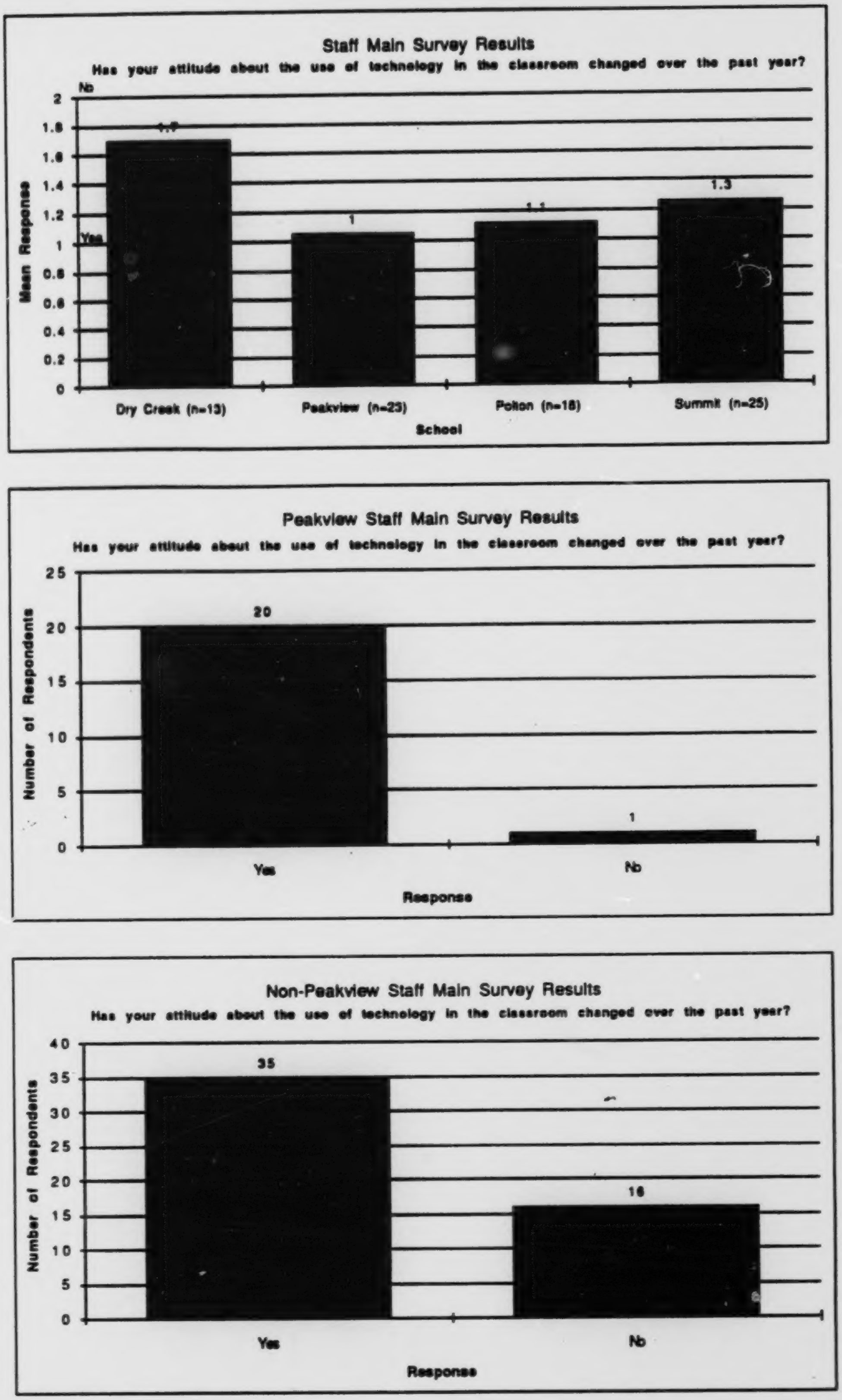

Staff Main Survey Results
Has your attitude about the use of technology in the classroom changed over the past year?
No
Yes
Mean Response
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1.7
1
1.1
1.3
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Has your attitude about the use of technology in the classroom changed over the past year?
Number of Respondents
25
20
15
10
5
0
20
1
Yes
No
Response
Non-Peakview Staff Main Survey Results
Has your attitude about the use of technology in the classroom changed over the past year?
Number of Respondents
40
35
30
25
20
15
10
5
0
35
16
Yes
No
Response

Figure 46.

In the fall of 1991, Peakview teachers completed a short survey concerning their changing practice and beliefs. Open-ended responses were completed under the headings "I used to..." and "Now I..." Below are representative responses to that survey (see Appendix D for complete responses):

*[I used to] ... think that there was no way I could even begin to develop a comfort level with the computer.*
*[Now I] ... know that at least there is hope!*

*[I used to]... watch.*
*[Now I]... try.*

*[I used to]... look for the "expert" to help kids who were stuck. .*
*[Now I]... try things out for myself -and by doing it daily several times, I'm learning some procedures by heart!*

*[I used to] ... be totally (100%) overwhelmed by the Mac.*
*[Now I] . . am only 70% overwhelmed by the Mac.*

*[I used to] ... save on my disk and have kids illustrate using crayons and markers.*
*[Now I] ... save on the file server and have kids illustrate using a computer.*

*[I used to] ... see the potential of computers for other people*
*[Now I]... see the potential for myself!*

*[I used to]... avoid computer at all cost.*
*[Now I] ... only avoid them during Bronco games.*

A number of Likert items (statements eliciting an agree/disagree response) were asked on the main survey to determine teacher attitudes toward technology. A summary table is provided below. Items are presented in order of response strength. Complete tables are presented in Appendix D. On 6 of the 9 items, Peakview teachers reported more positive attitudes than their counterparts.

| Likert Item | Peakview Teacher Modal Response | Non-Peakview Teacher Modal Response | Chi Square | p≤ |
|---|---|---|---|---|
| I am afraid computers are too complicated for me. | Strongly Disagree | Disagree | 19.11 | .001 |
| I want to learn new technology-related skills and teaching methods. | Strongly agree | Agree | 6.36 | .05 |
| Teaching is more fun when technology is involved. | Strongly agree/ Agree | Agree | 15.53 | .01 |
| Too much importance is put on technology in education. | Strongly Disagree | Disagree | ns | ns |
| I just do not have time to learn how to use a computer effectively. | Strongly Disagree | Disagree | 17.06 | .01 |
| Using technology helps me feel like a competent professional. | Agree | Agree | ns | ns |
| Advanced technical equipment is difficult for me to deal with. | Disagree | Agree | 18.44 | .05 |
| I would like to share with others my experience with technology. | Agree | Undecided | 16.97 | .01 |
| It's difficult to "keep up" with technological changes. | Agree | Agree | ns | ns |

Table 11. *Teacher responses to attitude items on the Main Survey.*

Positive attitudes also come through the interviews conducted with Peakview teachers:

> *I may have been a little skeptical, at first, but I am a true believer in the vital role computers have in our educational system!* Nora, Kindergarten teacher

> *Technology at Peakview has been a learning experience for all. I have learned a ton about the mechanics of the data file server within a network, writing programs, HyperCard stacks, laserdiscs, CD-ROM players and much more. But the real learning has been incorporating computers into the classroom environment.* Sandy, primary teacher

> *[W]hen I got here, I found out the added potential beyond word processing, spell checking, grammar checkers. CD-ROM, laserdisc, scanner, etc., it has changed my attitudes toward the computer.* Michael, intermediate teacher

> *Sure, the kids are stimulated...that stimulates me. I am very excited about what's going on.* Charlotte, primary teacher

> *Book reports have taken on an entire new meaning. It used to be that book reports used to be like pulling teeth. I'm not finding that to be the case now....We have a lot of math types of games that have been very helpful. It's my opinion that the basic skills needed some bolstering, and this has been excellent. These are not your typical drill and practice programs.* Michael, intermediate teacher

> *My goal is to learn more! I'm getting over a lot of my "fears" about computers, but there's an* **awful lot** *I still need to learn! I feel a comfort level settling in, but I need more information!!! More* **time** *to learn!!!* Nora, Kindergarten teacher

> *What I will always remember about this year is the realization that teachers need not be computer wizards...just learners.* Matt, intermediate teacher

## Teacher Comfort Levels

Table 12 summarizes teacher reports of how comfortable they feel using different computer tools.

| How comfortable are you using: | Peakview Teacher Modal Response | Non-Peakview Teacher Modal Response | Chi Square | p≤ |
|---|---|---|---|---|
| Word processing | Very comfortable | Very comfortable | 16.862 | .001 |
| Instructional software | Very comfortable | Somewhat comfortable | ns | ns |
| Videodisc viewing | Somewhat comfortable | Somewhat comfortable | 16.25 | .01 |
| Art/graphics | Somewhat comfortable | Somewhat comfortable | 8.47 | .05 |
| Database | Somewhat comfortable | Not very comfortable | ns | ns |
| Spreadsheet | Not very/Not at all comfortable | Not at all comfortable | ns | ns |
| Programming | Not at all comfortable | Not at all comfortable | ns | ns |

Table 12. *Teacher comfort levels with different software (from Main Survey).*

Statistically, Peakview teachers are more comfortable with word processing, arts/graphics applications, and laserdisc viewing.

Only 37% of the teachers surveyed said they were somewhat comfortable with databases. Databases are not a typical activity used with their students (see above). Most of the teachers are not comfortable with spreadsheet applications nor do they choose spreadsheet activities in instruction.

In spite of the trend, one Peakview teacher was enthusiastic about using databases for organizing information in the classroom and for professional uses:

> *I use the database a lot to generate lists. I can take on my database...all students, teachers... regrouping of kids and teacher combinations. Team teaching kinds of activities... it helps a lot to have kids and teachers on a database.*
>
> *Lots of recordkeeping on the computer. More anecdotal notes, now I'm getting away from traditional grading ...toward note-keeping. I use the database a lot to generate lists. I can take on my database...all students, teachers...regrouping of kids and teacher combinations. Team teaching kinds of activities...it helps a lot to have kids and teachers on a database. Personal management...keeping a list on the wall for fire drill.* Michael, intermediate teacher

## Student Perceptions of their Teachers

From the standpoint of students, teachers are generally perceived as being supportive of technology (Figure 47). Peakview students reported more encouragement from teachers than non-Peakview students ($\chi^2$=76.56, p<.001). Primary students generally followed a similar pattern, though the differences were not statistically significant (Figure 48).

Students were also asked how much their teachers seemed to enjoy using the technology (Figures 49 and 50). Again, Peakview students reported their teachers enjoying the technology more than non-Peakview students.

Students reported that their teachers usually let them hand in work using the computer (see Figures 53 and 54).

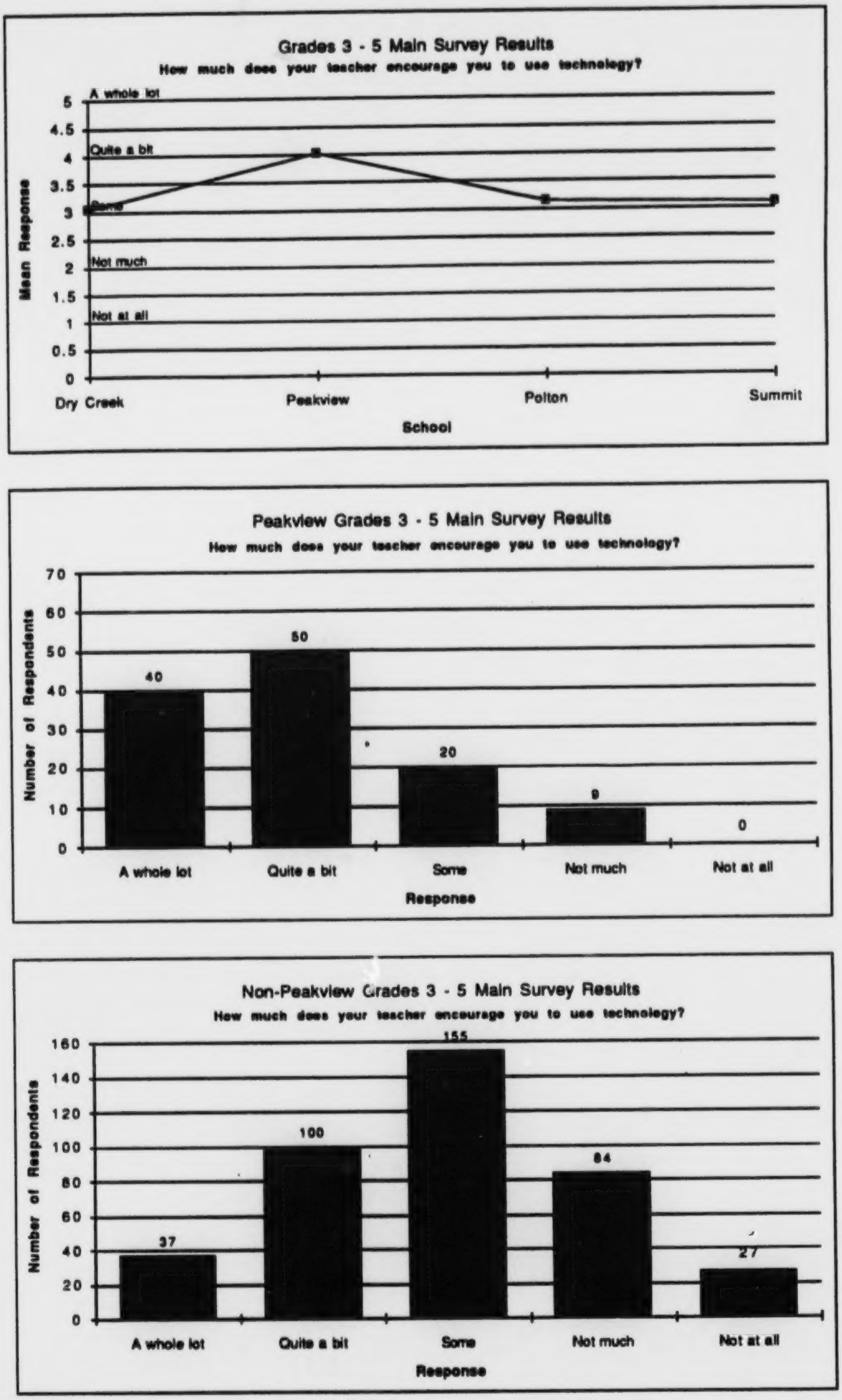

Grades 3 - 5 Main Survey Results
How much does your teacher encourage you to use technology?
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
A whole lot
Quite a bit
Some
Not much
Not at all
Dry Creek
Peakview
Polton
Summit
School
Peakview Grades 3 - 5 Main Survey Results
How much does your teacher encourage you to use technology?
Number of Respondents
70
60
50
40
30
20
10
0
40
50
20
9
0
A whole lot
Quite a bit
Some
Not much
Not at all
Response
Non-Peakview Grades 3 - 5 Main Survey Results
How much does your teacher encourage you to use technology?
Number of Respondents
160
140
120
100
80
60
40
20
0
37
100
155
84
27
A whole lot
Quite a bit
Some
Not much
Not at all
Response

Figure 47.

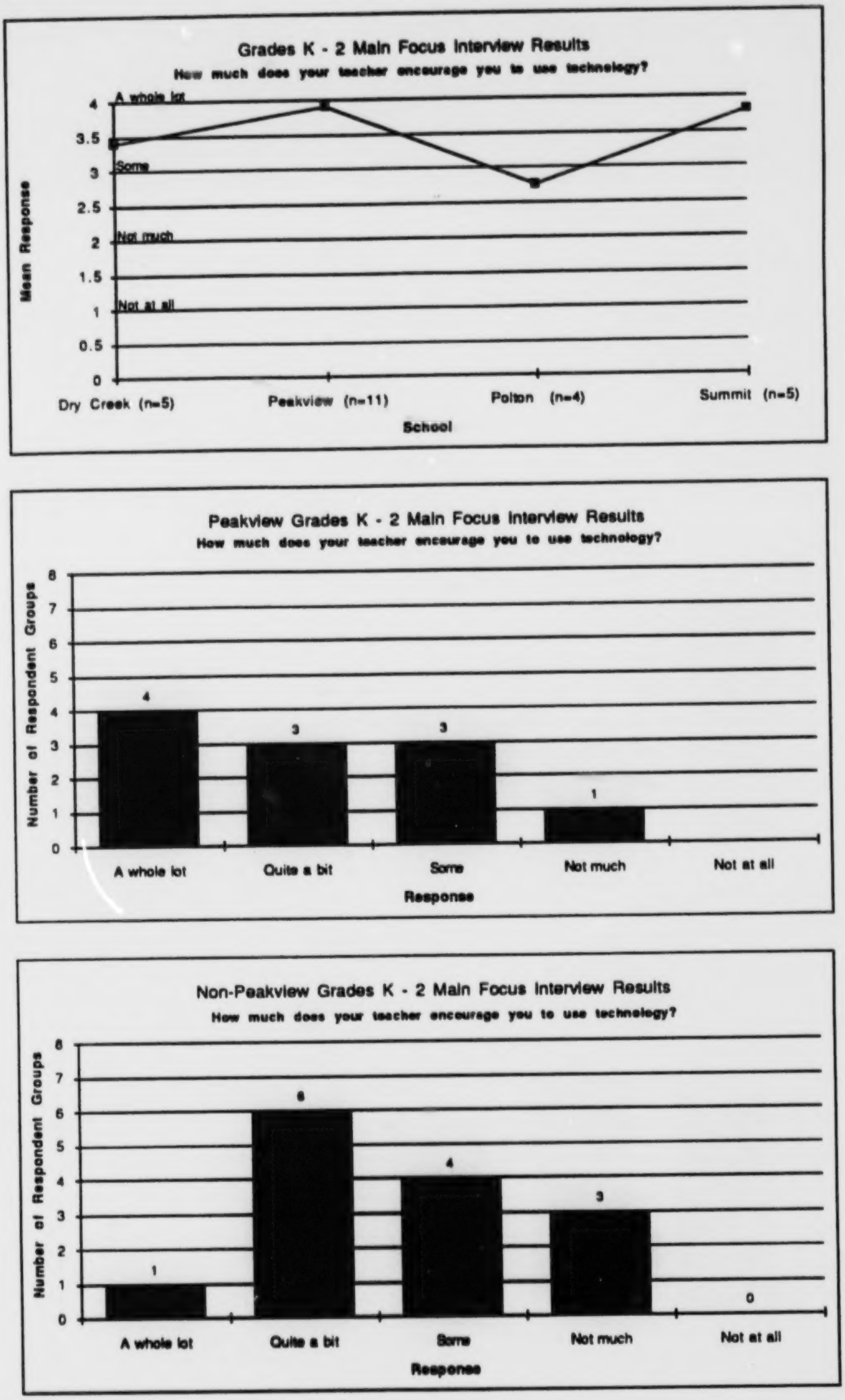

Grades K - 2 Main Focus Interview Results
How much does your teacher encourage you to use technology?
Mean Response
A whole lot
Some
Not much
Not at all
0
0.5
1
1.5
2
2.5
3
3.5
4
Dry Creek (n=5)
Peakview (n=11)
Polton (n=4)
Summit (n=5)
School
Peakview Grades K - 2 Main Focus Interview Results
How much does your teacher encourage you to use technology?
Number of Respondent Groups
0
1
2
3
4
5
6
7
8
4
3
3
1
A whole lot
Quite a bit
Some
Not much
Not at all
Response
Non-Peakview Grades K - 2 Main Focus Interview Results
How much does your teacher encourage you to use technology?
Number of Respondent Groups
0
1
2
3
4
5
6
7
8
1
6
4
3
0
A whole lot
Quite a bit
Some
Not much
Not at all
Response

Figure 48.

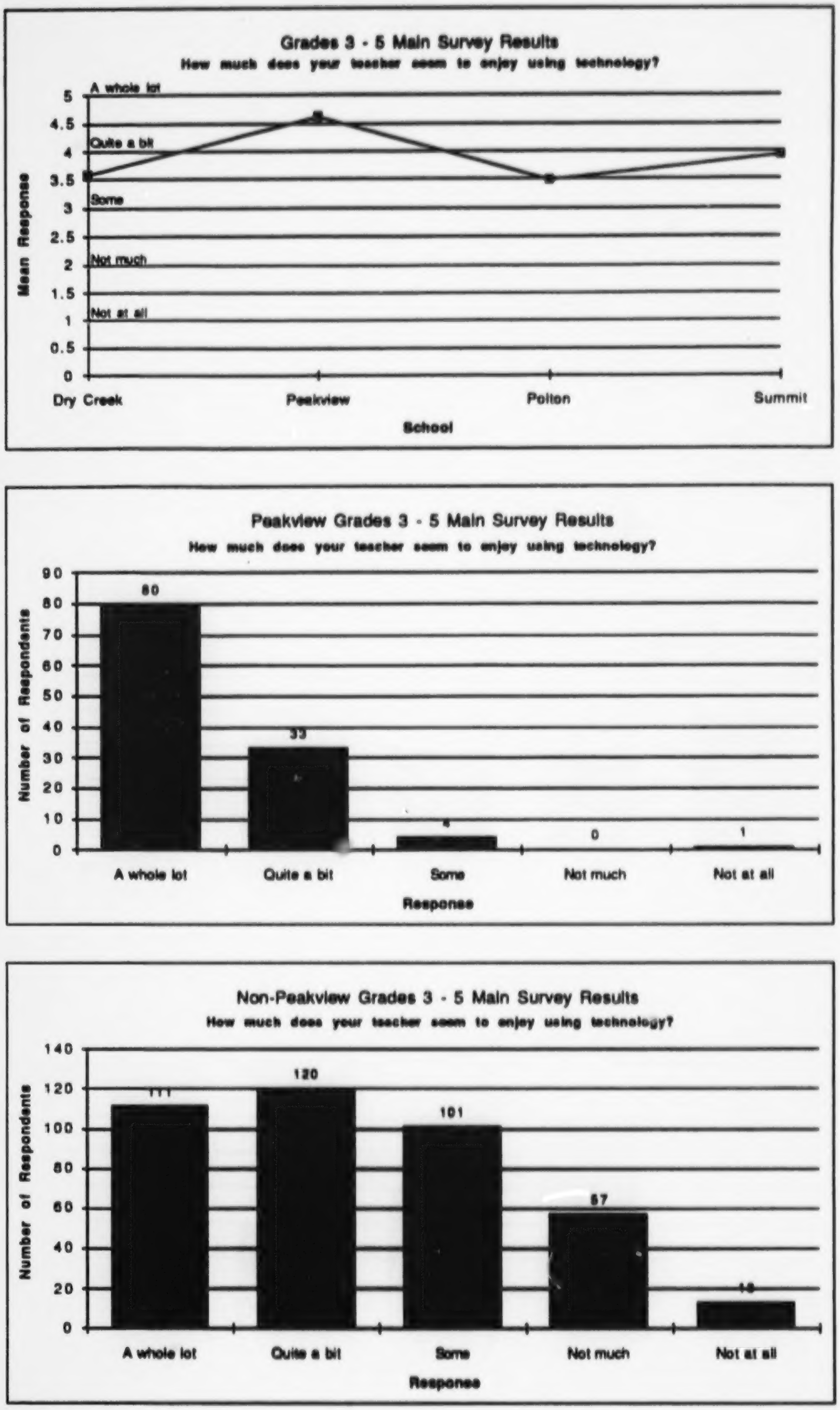
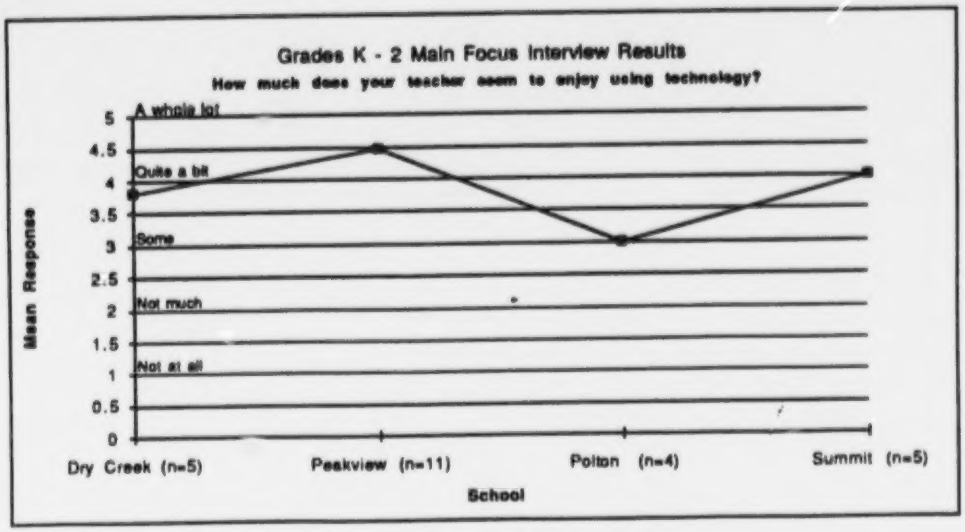
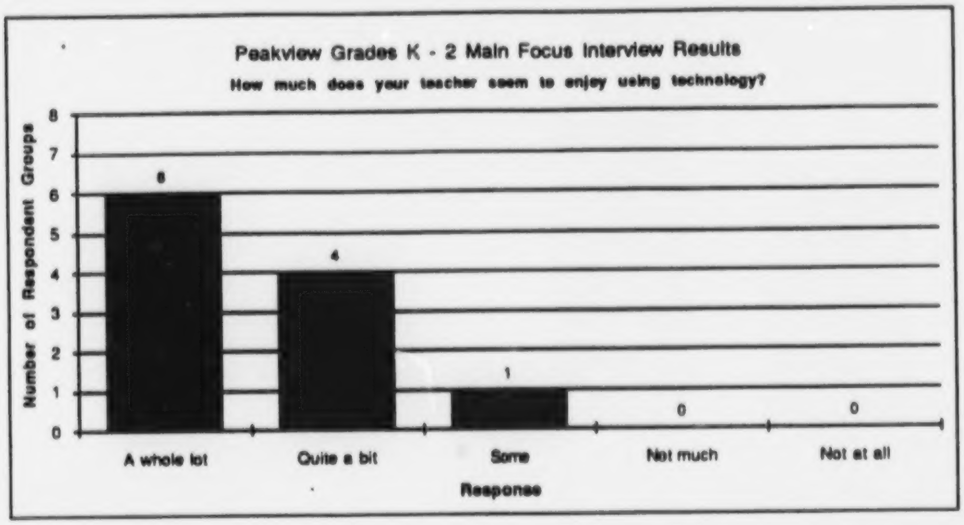

Grades 3 - 5 Main Survey Results
How much does your teacher seem to enjoy using technology?
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
A whole lot
Quite a bit
Some
Not much
Not at all
Dry Creek
Peakview
Polton
Summit
School
Peakview Grades 3 - 5 Main Survey Results
How much does your teacher seem to enjoy using technology?
Number of Respondents
90
80
70
60
50
40
30
20
10
0
80
33
4
0
1
A whole lot
Quite a bit
Some
Not much
Not at all
Response
Non-Peakview Grades 3 - 5 Main Survey Results
How much does your teacher seem to enjoy using technology?
Number of Respondents
140
120
100
80
60
40
20
0
111
120
101
57
13
A whole lot
Quite a bit
Some
Not much
Not at all
Response

Figure 49.





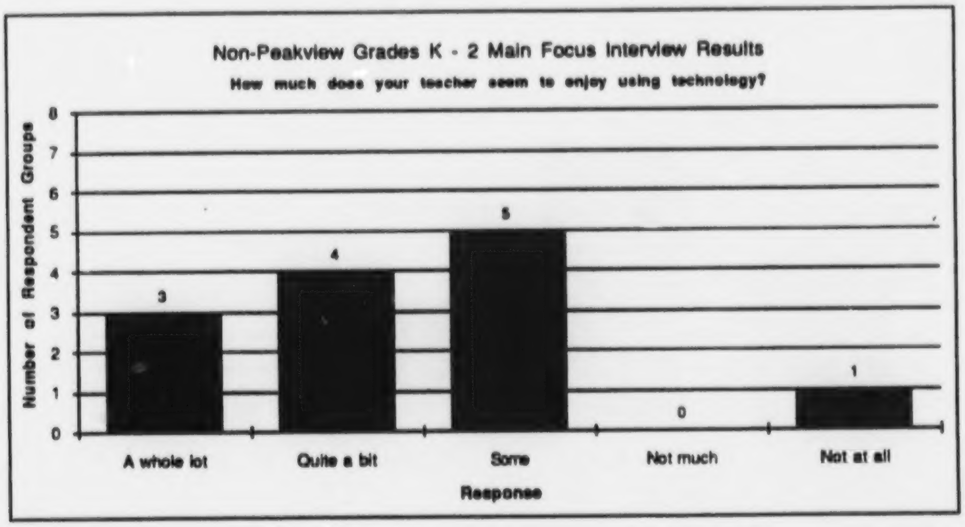


Figure 50.

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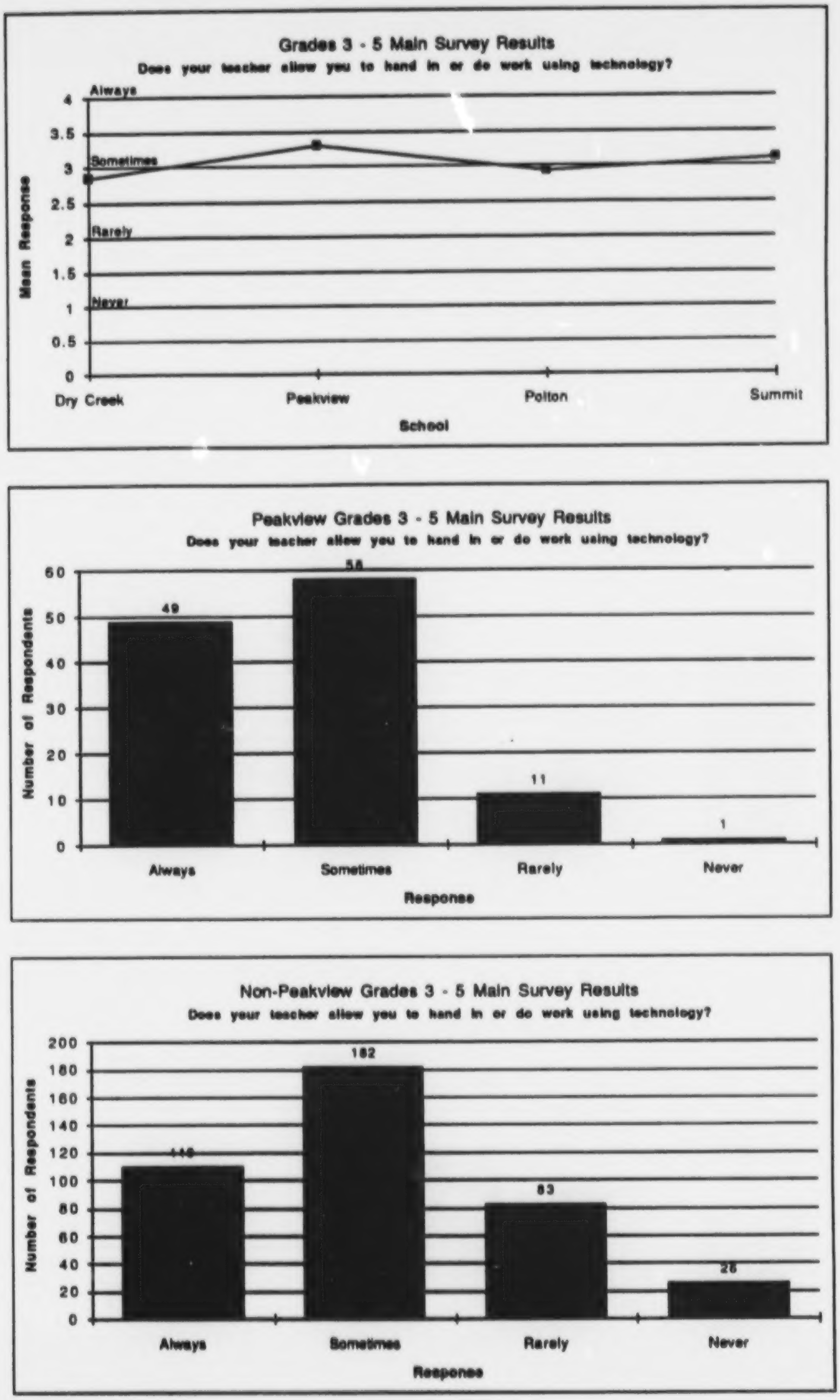

Grades 3 - 5 Main Survey Results
Does your teacher allow you to hand in or do work using technology?
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
Always
Sometimes
Rarely
Never
Dry Creek
Peakview
Polton
Summit
School
Peakview Grades 3 - 5 Main Survey Results
Does your teacher allow you to hand in or do work using technology?
Number of Respondents
60
50
40
30
20
10
0
49
58
11
1
Always
Sometimes
Rarely
Never
Response
Non-Peakview Grades 3 - 5 Main Survey Results
Does your teacher allow you to hand in or do work using technology?
Number of Respondents
200
180
160
140
120
100
80
60
40
20
0
110
182
83
26
Always
Sometimes
Rarely
Never
Response

Figure 51.

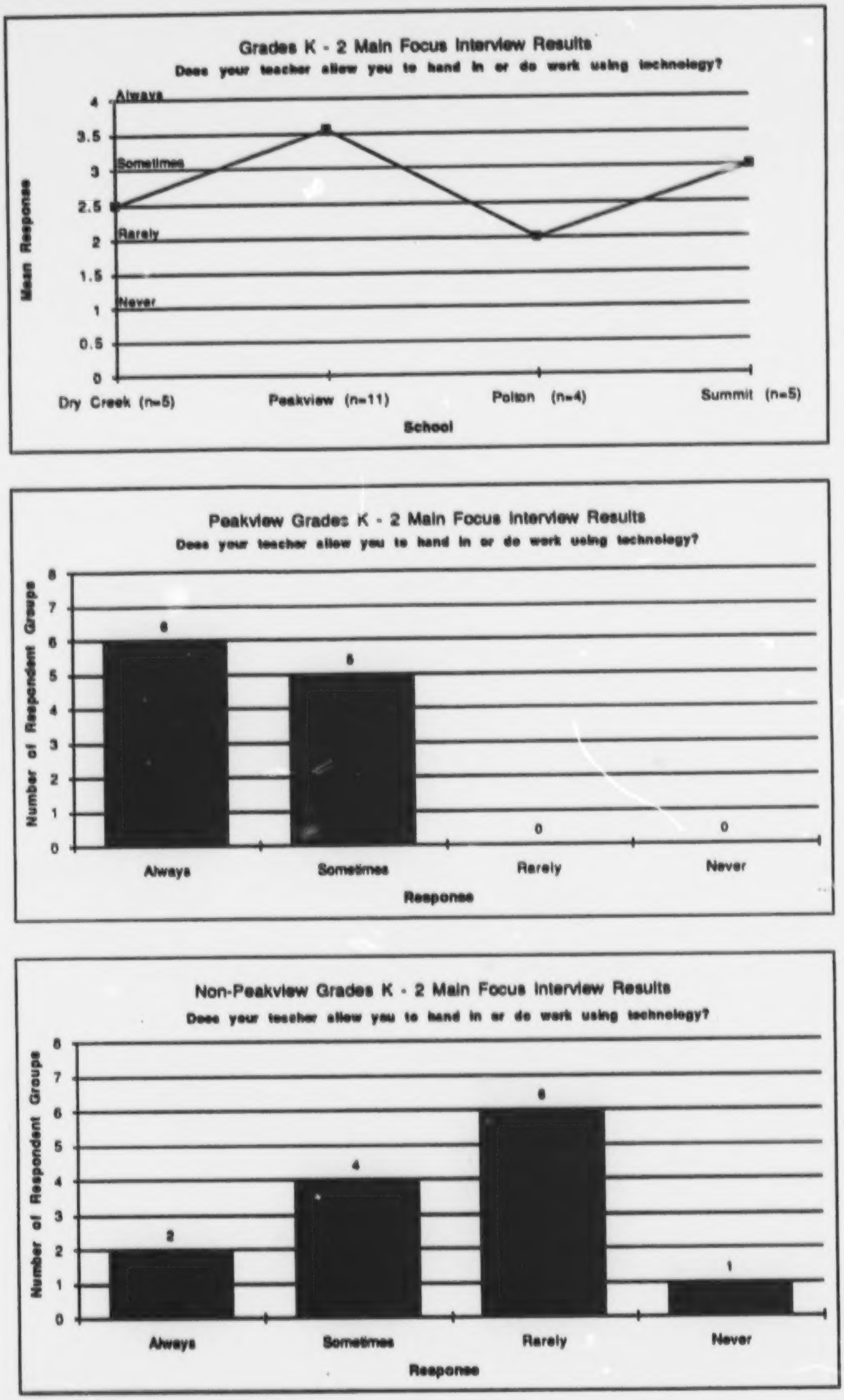
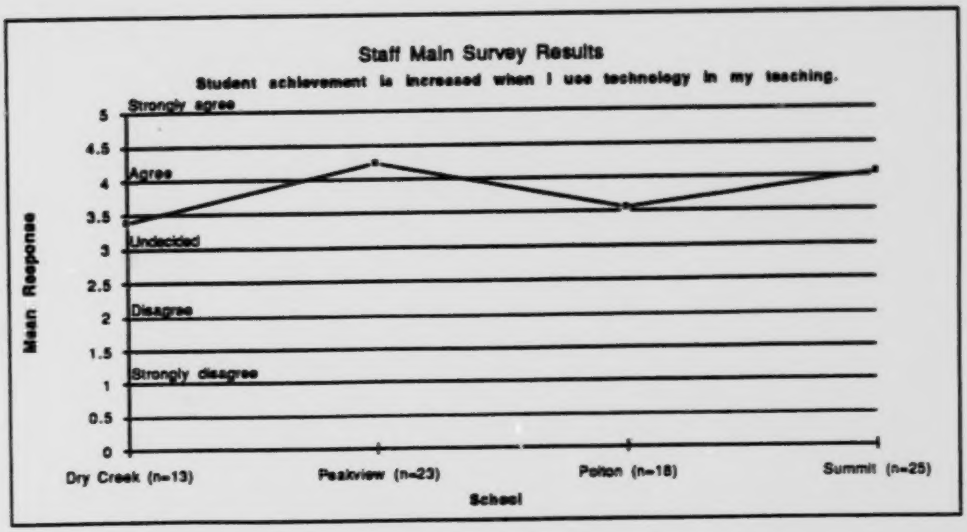

Grades K - 2 Main Focus Interview Results
Does your teacher allow you to hand in or do work using technology?
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
Always
Sometimes
Rarely
Never
Dry Creek (n=5)
Peakview (n=11)
Polton (n=4)
Summit (n=5)
School
Peakview Grades K - 2 Main Focus Interview Results
Does your teacher allow you to hand in or do work using technology?
Number of Respondent Groups
8
7
6
5
4
3
2
1
0
6
5
0
0
Always
Sometimes
Rarely
Never
Response
Non-Peakview Grades K - 2 Main Focus Interview Results
Does your teacher allow you to hand in or do work using technology?
Number of Respondent Groups
8
7
6
5
4
3
2
1
0
2
4
6
1
Always
Sometimes
Rarely
Never
Response

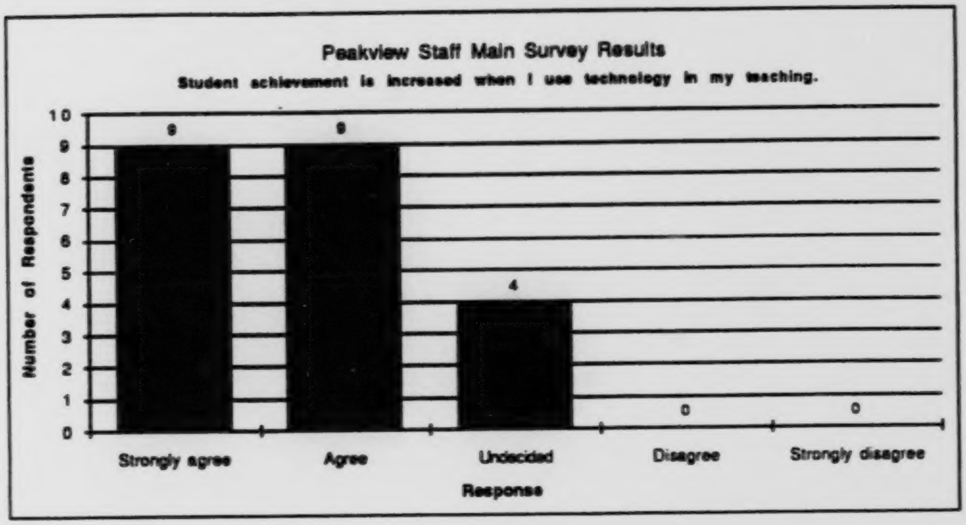
Figure 52.

In summary, teachers underwent a significant shift in their attitudes toward technology as they completed their first year of teaching at Peakview. They became more willing to take risks with their students, and more confident in their ability to use and learn technologies. Their attitudes toward technology are generally more positive than teachers in comparison schools.

## Student Achievement

Eighteen of 22 (82%) of the Peakview teachers agreed that student achievement is increased when they use technology in teaching (see Figure 53). None disagreed with the statement.


Staff Main Survey Results
Student achievement is increased when I use technology in my teaching.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
Student achievement is increased when I use technology in my teaching.
Number of Respondents
10
9
8
7
6
5
4
3
2
1
0
9
9
4
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

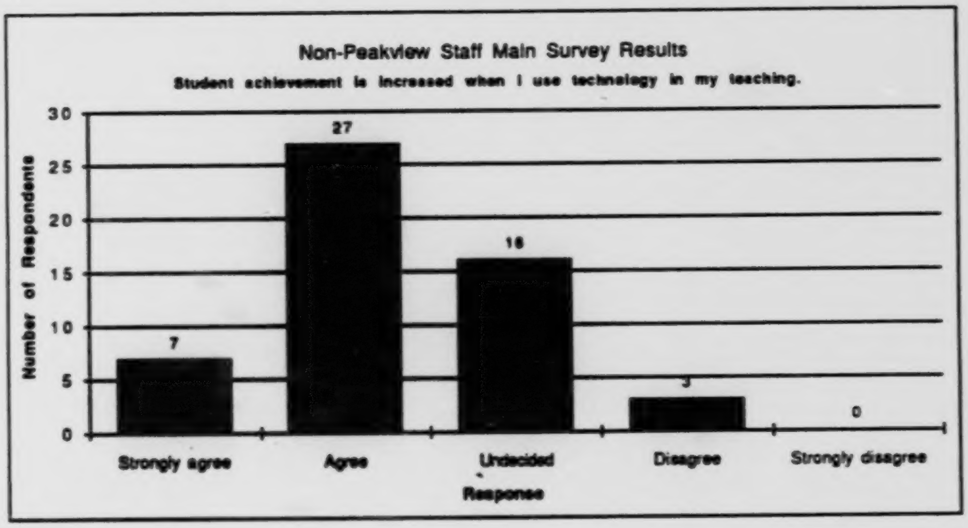

Non-Peakview Staff Main Survey Results
Student achievement is increased when I use technology in my teaching.
Number of Respondents
30
25
20
15
10
5
0
7
27
16
3
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 53.

The following comments from Peakview teachers provide a general overview of the impact of technology on student achievement, and illustrate the positive tone that runs through our data set for this question.

Teacher responses to the Main Survey:

> *Technology has enhanced teaching and learning at Peakview.*
>
> *[Technology] also affects individual learning in a positive, beneficial way.*
>
> *[Technology] reinforces mini-lessons; visual learners bloom.*
>
> *Students need to be using computers as an integral part of their day. As we continue to add computers to the classroom, achievement will increase in all areas.*
>
> *[Technology] benefits students' progression in all academic areas.*

From teacher interviews:

> *I think they are excited about learning. It's a new avenue...they are doing writing, [and] reading things I didn't think first- and second- graders could do. It's interesting...I have kids who are working on projects [and] units...the learning is more in depth...more opportunities, not just a book and paper.* Charlotte, primary teacher
>
> *Supermunchers—the kids taught themselves new words so they'd be able to do it. They really have made themselves learn the new words.* Ginny, primary teacher
>
> *Achievement gains in reading and writing are very pronounced, especially with kids on the low end.* Adam, intermediate teacher
>
> *I've never had a class that has known all the letters. This year every child in my class knows every letter of the alphabet. A lot of it is due to the computer. I can't say exactly, but I feel certain that it is.* Mary, Kindergarten teacher

## Attainment of Basic Skills

The Staff Main Survey asked Peakview staff members if technology is a good way to help students learn basic skills. All 22 (100%) of the sample strongly agree or agree (Figure 54). There is general agreement across all four schools on this question. Teachers report achievement gains in reading, writing, and math:

> *My students seem to be making better progress this year than I've noticed in previous years. All of my kindergarten students now know all of their upper and lower case letters, and I feel that the computers in my classroom have played an important part in this.* Mary, Kindergarten teacher

*I can only speak for my kids, but their writing has come way far from what I've seen in the past. [They've] published books. Kindergarten-level publishing. Almost a published book from every child...some are working on their second or third books.* Nora, Kindergarten teacher

*We have a lot of math types of games that have been very helpful. It's my opinion that the basic skills needed some bolstering, and this has been excellent. These are not your typical drill and practice programs.* Michael, intermediate teacher

Other comments by Peakview teachers include:

*I think they are excited about learning. It's a new avenue...they are doing writing, [and] reading things I didn't think first- and second- graders could do.* Charlotte, primary teacher

*Because the programs allow the children to make choices for themselves, I would say, yes, there is improvement in skills.* Brad, Kindergarten teacher

*It is a lot more motivating for kids struggling, especially kids who are having trouble with reading. They feel more comfortable with the information.* Tom, intermediate teacher

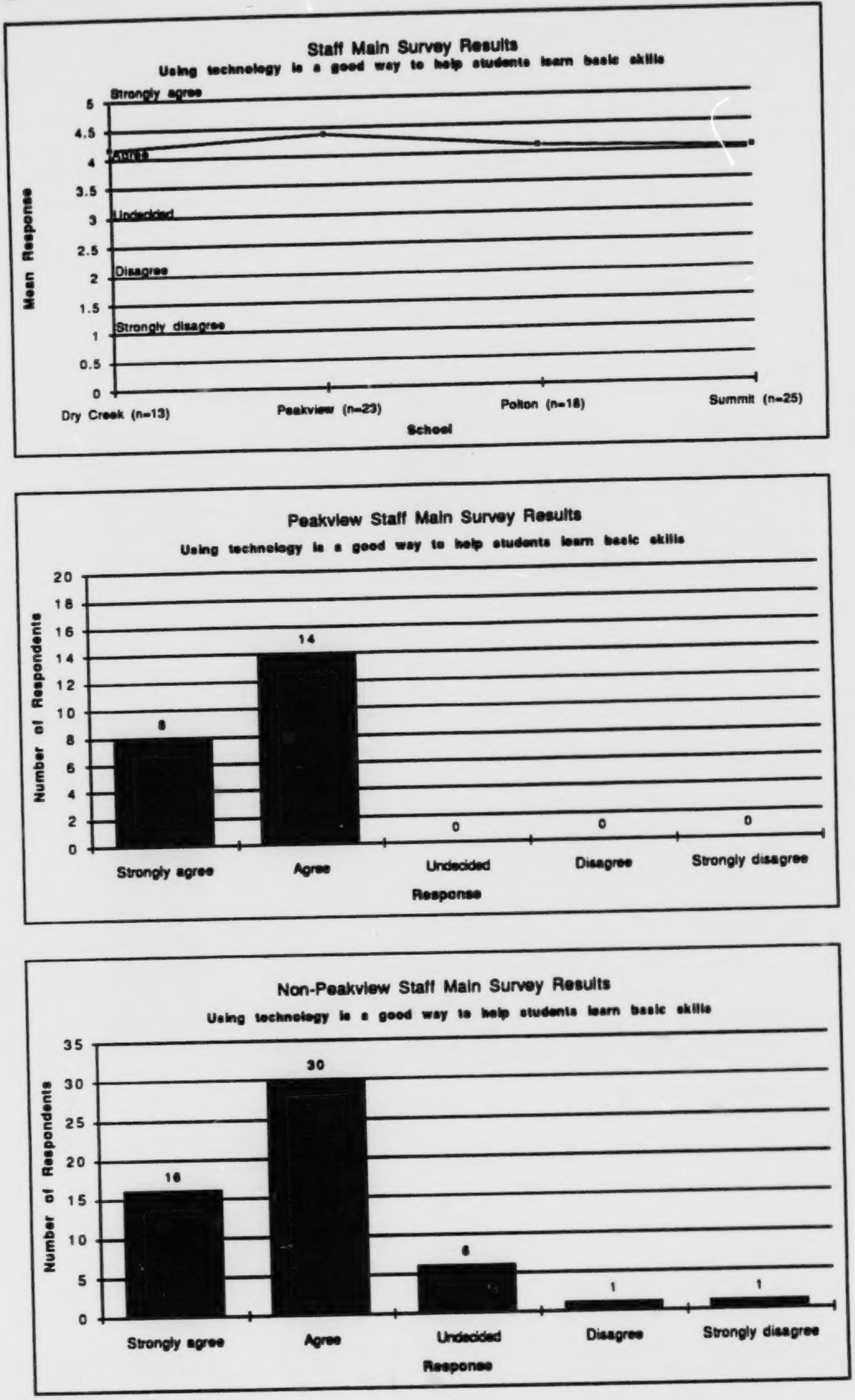
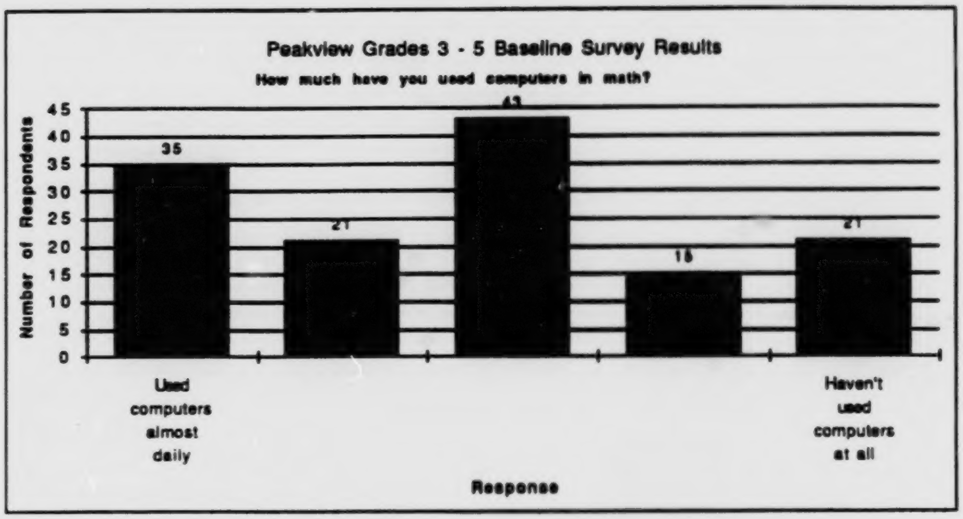
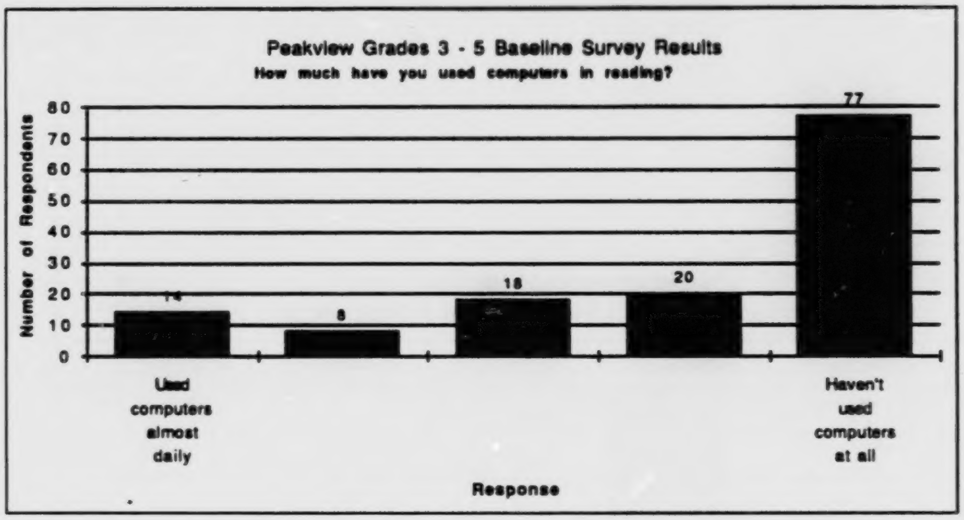
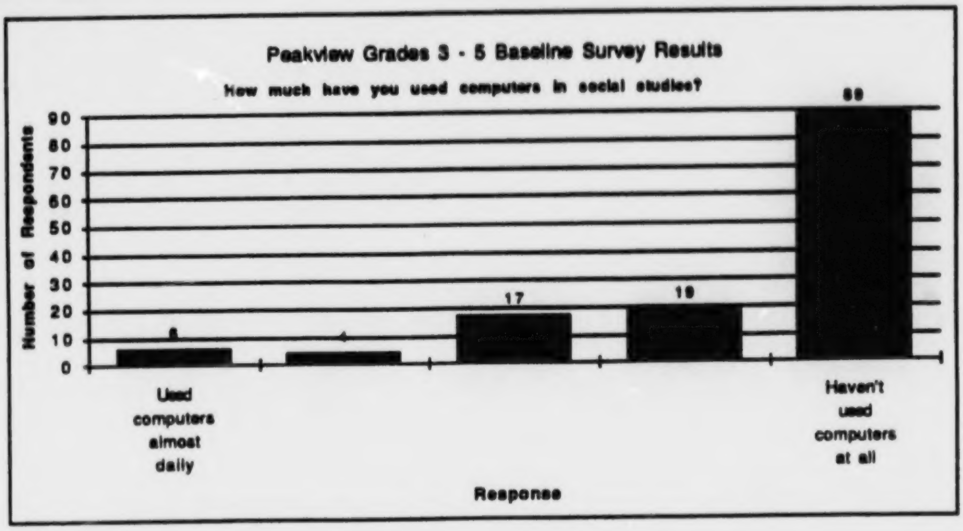

Staff Main Survey Results
Using technology is a good way to help students learn basic skills
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Using technology is a good way to help students learn basic skills
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
8
14
0
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response
Non-Peakview Staff Main Survey Results
Using technology is a good way to help students learn basic skills
Number of Respondents
35
30
25
20
15
10
5
0
16
30
6
1
1
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 54.

Figure 55 shows Baseline Survey responses given to 3rd to 5th grade Peakview students at the beginning of the 1991–92 school year. According to these students, computers are used a moderate amount for math (26% of the 135 respondents said they use computers for math almost daily). Usage for reading, social studies and science is perceived as minimal in August. Observations and samples of student work later in the year, however, indicated significant use of technology for the preparation of reports and projects in social studies and science (project work is discussed below).






Peakview Grades 3 - 5 Baseline Survey Results
How much have you used computers in social studies?
Number of Respondents
0
10
20
30
40
50
60
70
80
90
6
4
17
19
89
Used computers almost daily
Haven't used computers at all
Response

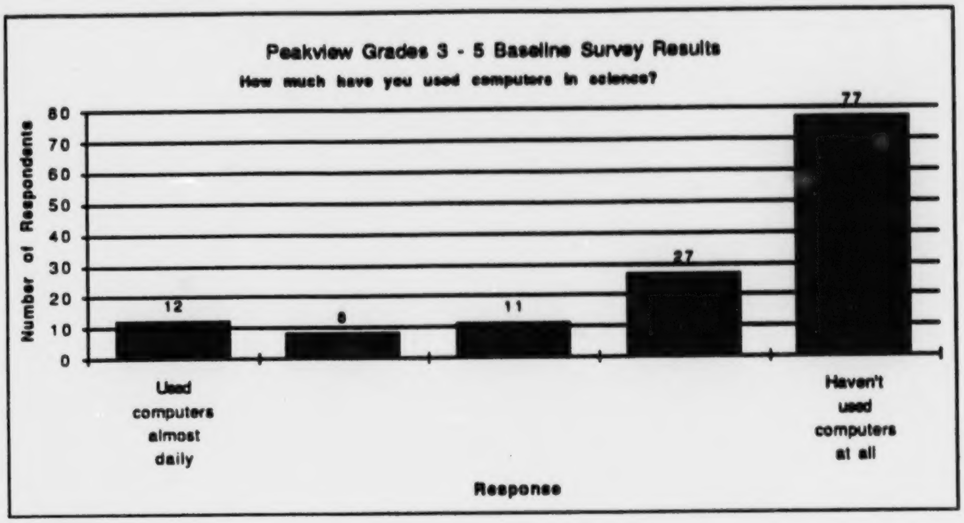

Peakview Grades 3 - 5 Baseline Survey Results
How much have you used computers in science?
Number of Respondents
0
10
20
30
40
50
60
70
80
12
8
11
27
77
Used computers almost daily
Haven't used computers at all
Response

Figure 55.

During interviews with intermediate students at Peakview, 83% indicated they use technology for writing, 57% indicated that they use technology to learn mathematics, and only 9% said they use technology for reading. Comments by students included:

> *Research with laserdisc, to do math on, to write essays, to read and find stuff about topics.* David

> *Most of the time we just use the computers for writing and math, and for fractions sometimes.* Kyra

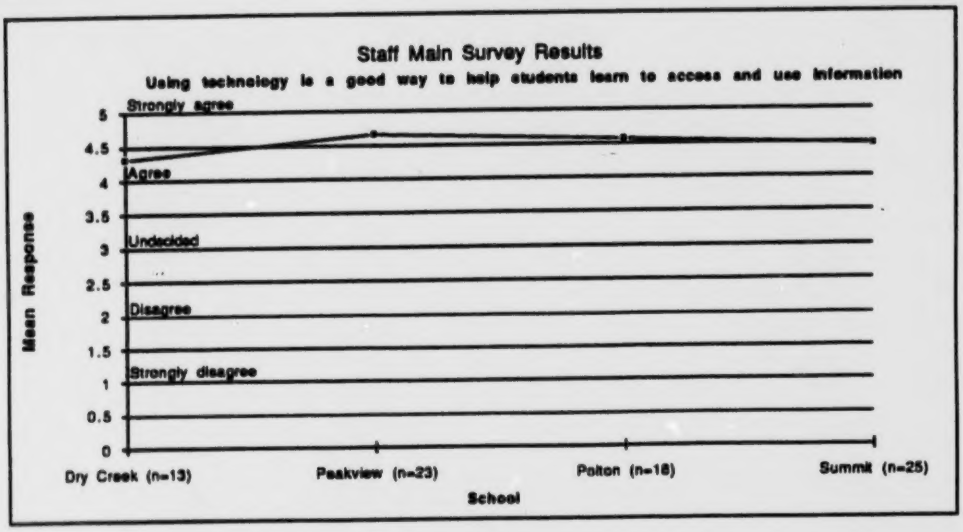
> *Well, I use it for math, HyperCard stacks like writing for novels, and I use it for games. I use it for Munchers, writing, research and that's probably all.* Jimmy

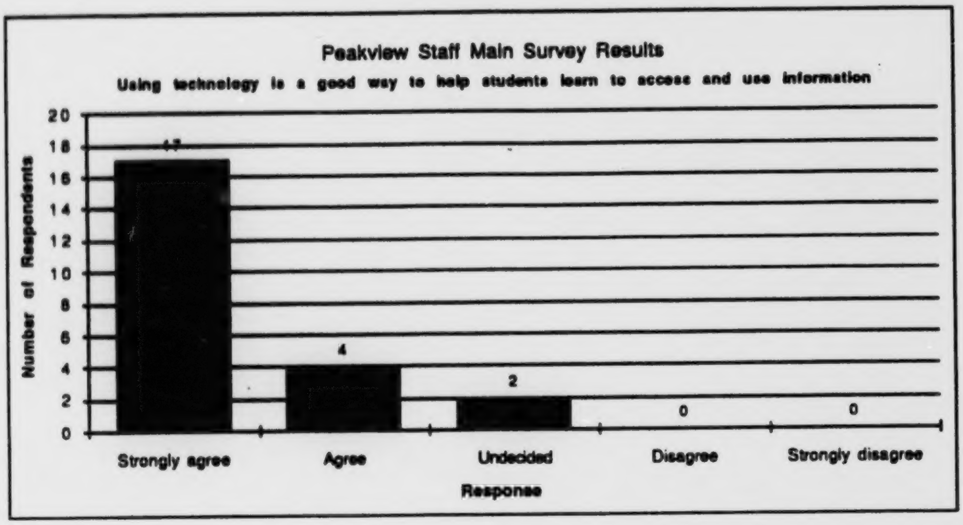
> *You do math on the computers...that helps you.* Abagail

In summary, the impact of technology on the attainment of basic skills seems to be positive, most noticeably in the areas of writing and mathematics skills. Students are using the technology, and teachers report improvements in learning. The impact of technology on writing and other forms of communication will be discussed in detail below. The Baseline Survey perceptions of students and their comments during interviews would seem to indicate only occasional usage of technology for reading. We are unable to judge whether reading may be facilitated indirectly through constant interaction with the technology.

## Access and Use of Information

Figure 56 indicates that 21 of 23 (91%) of the Peakview staff members agree that using technology is a good way to help students access and use information. There was general agreement (93%) across the sample of teachers from all schools in the survey.


Staff Main Survey Results
Using technology is a good way to help students learn to access and use information
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
Using technology is a good way to help students learn to access and use information
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
17
4
2
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

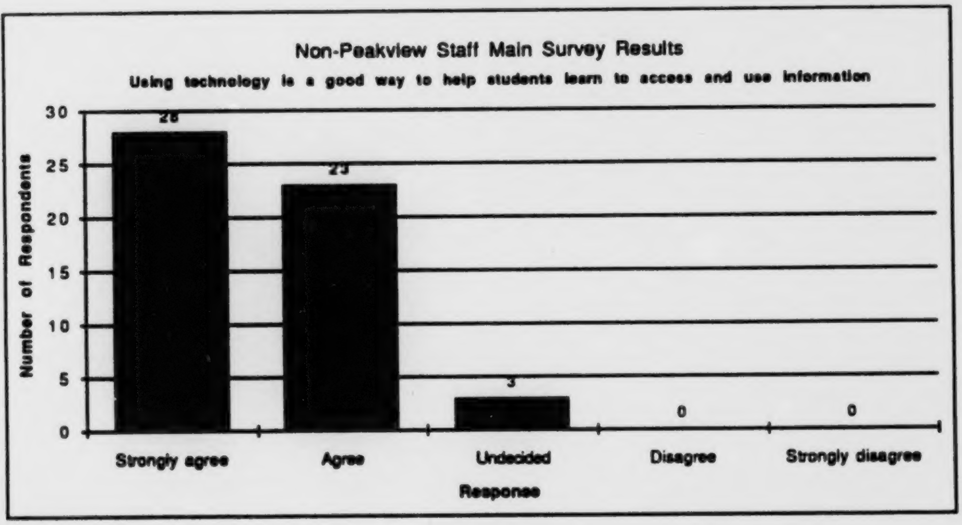

Non-Peakview Staff Main Survey Results
Using technology is a good way to help students learn to access and use information
Number of Respondents
30
25
20
15
10
5
0
28
23
3
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 56.

Peakview staff comments on the subject of accessing information include:

> *Can I look up this? Can I research that? Kids are in control of their learning. They've become very independent working with the technology, and they know what they're after.* Patricia, media specialist

> *It makes a big difference in the way students learn. It really makes a difference in the way kids look at information. There are so many more alternatives for them to find information with the technology, and they are exciting and motivating ways.* Patricia, media specialist

> *Kids seeing themselves as information seekers and users...using laserdiscs, GTV, Visual Almanac...turning around and creating products. I've always valued kids being able to have lots of free choice. Research writing, reading topics...technology has added to that, one more facet where kids can explore and be producers. That is the biggest [effect].* Adam, intermediate teacher

Students appreciate being able to access information using technology:

> *Every couple of months or weeks we have to do research on something. We go to the media [center], and we use laserdiscs, Visual Almanac, to play parts about the animal or people. When we're doing reports, here's a book...we can put a picture on the scanner and we scan it. The things that helps me learn the most are the laserdiscs 'cause it tells me all about stuff—animals and famous people.* Billy

> *Computers help you a lot because you can get all the information you need.* Jimmy

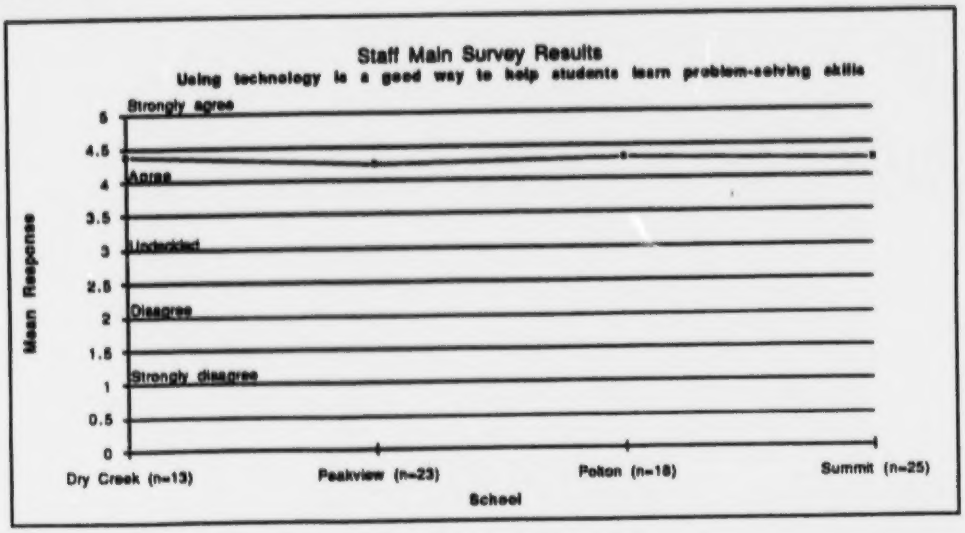
> *I think I learn more from technology than from a book. You can go to different things that'll teach you stuff. You could go to a library and check out a book about cheetahs, but you can do it faster and you learn a lot more from a CD-ROM.* Marcus

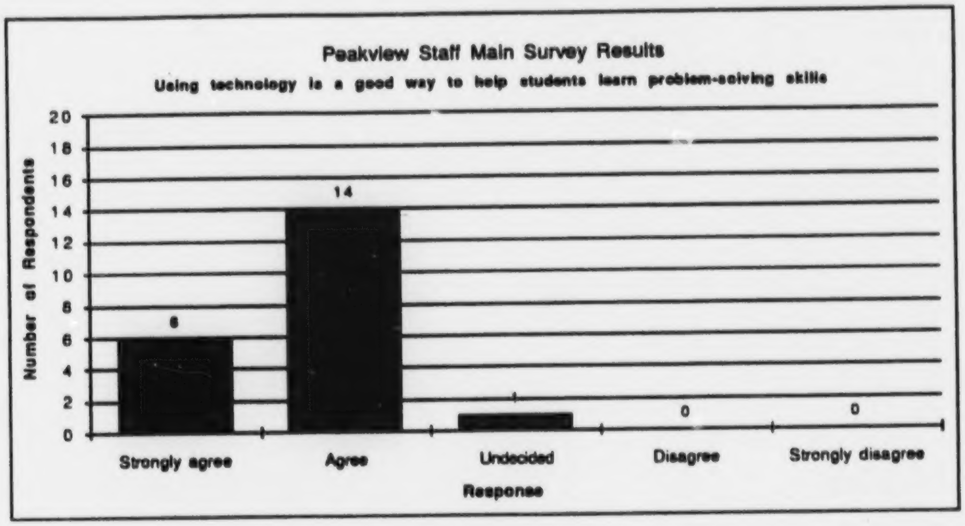
> *The information it gives me. It's almost like a humungous book, except it's faster and easier to write it down.* Curt

To the extent that students can obtain answers to their questions, they reduce their dependence on the teacher as a source of knowledge. Seen in this way, information use is an important precursor to independent research activities. From the available evidence, technology is a definite aid to students' independent access and use of information at Peakview.

## Problem-Solving Skills

The Staff Main Survey asked if technology is a good way to help students learn problem-solving skills. Figure 57 indicates that 20 of 21 (95%) strongly agree or agree, with widespread agreement (98%) among all four schools. However, only 2 of the 15 staff members interviewed at Peakview stated that they have develop specific technology-related problem-solving teaching strategies; only 4 of 15 indicated that technology has a positive impact on students' problem-solving learning outcomes.


Staff Main Survey Results
Using technology is a good way to help students learn problem-solving skills
Mean Response
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
Using technology is a good way to help students learn problem-solving skills
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
6
14
1
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

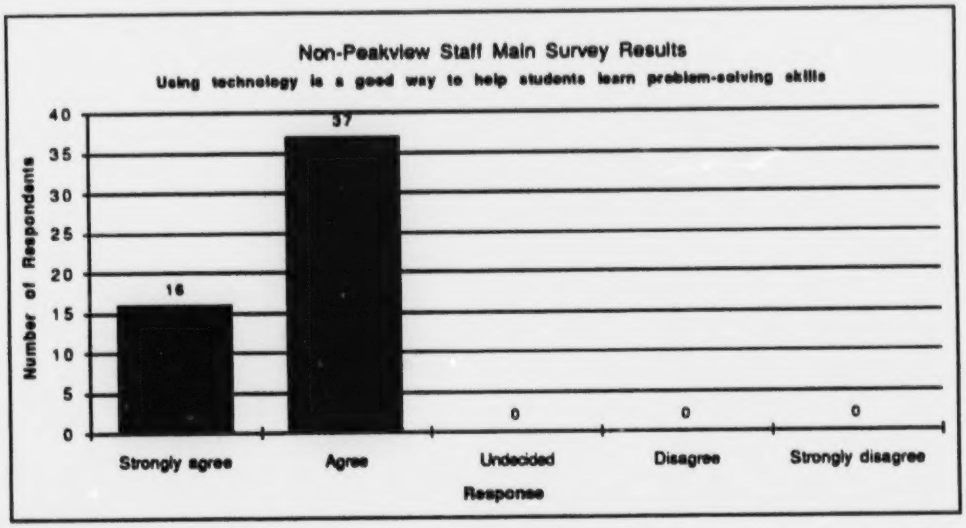

Non-Peakview Staff Main Survey Results
Using technology is a good way to help students learn problem-solving skills
Number of Respondents
40
35
30
25
20
15
10
5
0
16
37
0
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 57.

Peakview teacher interview comments on problem solving issues include:

> *Some improvements in math problem solving (Math Blaster Mystery).* Kate, intermediate teacher

> *Problem solving...I have never given direct lessons on the computer. Most kids figure out things on their own.* Ginny, primary teacher

> *We have a lot of math types of games that have been very helpful. It's my opinion that the basic skills needed some bolstering, and this has been excellent. These are not your typical drill and practice programs—MathBlasters, for example.* Michael, intermediate teacher

> *What we are doing with young kids is allowing them to accept computers as a natural part of thinking, problem solving and processing information. We need to be more realistic about the tools that kids ought to be using to prepare them for how people work. Workplace problem solving. I'm not using the technology very much in the area of math and science. That's a goal of mine.* Matt, intermediate teacher

> *I'm not spending as much time with skills, and I get to spend more time with problem solving.* Tom, intermediate teacher

> *Language, reading, writing get heavy use, but [more] math-science software could also be used.* Adam, intermediate teacher

In summary, activities utilizing technology for problem-solving skills development were acknowledged as being important by teachers at Peakview. Broadly construed, writing and research activities can be thought of as problem-solving activities. Several mathematics drill and practice games were popular with students and teachers; however, these are generally designed to teach basic skills rather than higher-level problem-solving skills. Some teachers at Peakview indicated a need for more computer software, laserdiscs, and other materials that were specifically designed for problem-solving. In this regard, at the end of the school year plans were being made to procure the *Jasper Woodbury Adventure Series*, multimedia problem solving instruction developed by Vanderbilt University.

## Oral and Written Communication Skills

As mentioned above, the impact of technology on writing processes is encouraging. Figure 58 shows the response to the Staff Main Survey question, *Using technology is a good way to help students learn oral and communication skills.* From the sample of 22 staff members, 18 (82%) agreed with the statement. Non-Peakview staff also agreed, but a statistically significant difference existed between Peakview and non-Peakview responses ($\chi^2=11.48$, $p<.05$). Using technology for writing was identified as a teaching strategy by 8 of 15 teachers during Peakview teacher interviews. Also, 11 of 15 teachers made positive comments regarding student writing process learning outcomes.

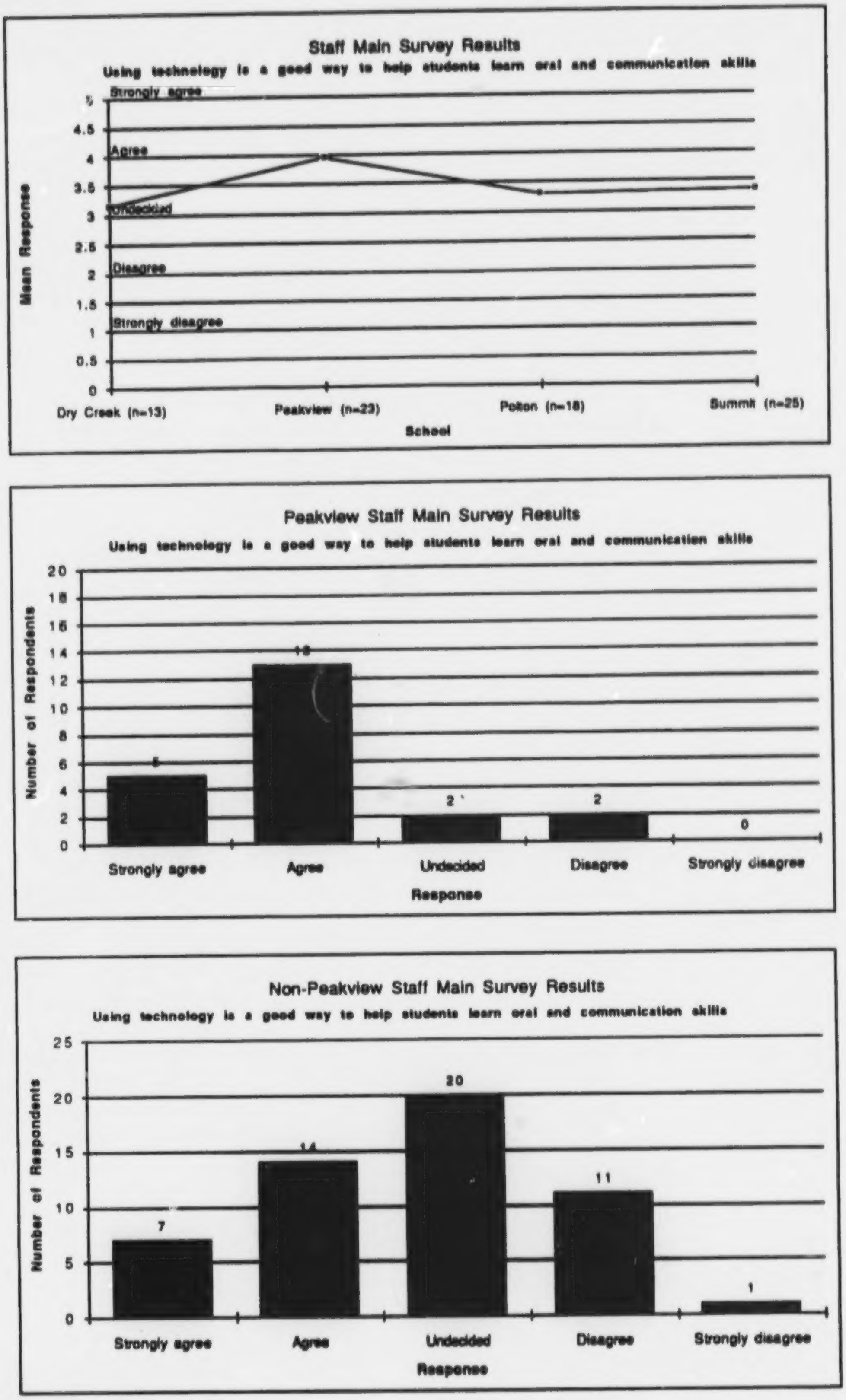

Staff Main Survey Results
Using technology is a good way to help students learn oral and communication skills
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Using technology is a good way to help students learn oral and communication skills
Number of Respondants
20
18
16
14
12
10
8
6
4
2
0
5
13
2
2
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response
Non-Peakview Staff Main Survey Results
Using technology is a good way to help students learn oral and communication skills
Number of Respondents
25
20
15
10
5
0
7
14
20
11
1
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 58.

Teacher interviews corroborate the value of technology in developing communication skills:

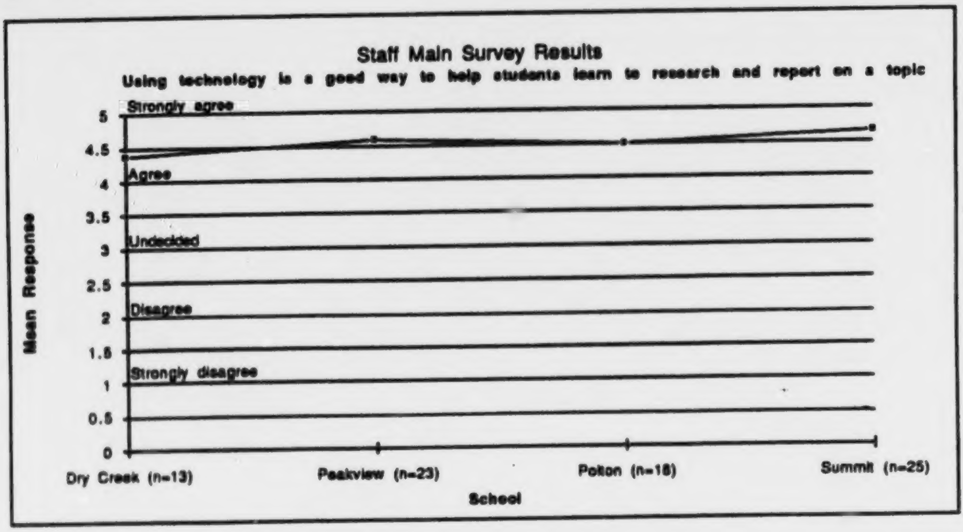
> *I think for my students, especially when I think of writing, the achievement of kids...being sure that they're editing and going through those processes...I see them [at] a higher level...grammatical...voice... mechanics improved quite a bit.* Matt, intermediate teacher.
>
> *They understand the writing process better.* Kate, intermediate teacher
>
> *They can write a report, include graphics, sound, color. As a 1st grade teacher, I've never had kids come up and say, 'Can I write a report on this or that?' Kids want to write reports. They think it's real fun to do their writing at the computer; and the ones that I see doing that quite often are the ones that would drop out of the activity. Their fine motor isn't very good, not as sophisticated.* Ginny, primary teacher
>
> *Kids have become much more computer literate. It has certainly improved writing. Old method: write on paper first, then copy it. Now they prefer writing and editing directly on the computer. Particularly lower-end [ability] kids are eager to be on the computer. It was a hook to have them write.* Elizabeth, intermediate teacher
>
> *The lower achievers have more of an opportunity to do some writing. It's easier to proofread and edit. Kids like software and like using computers. The education software that we have are learning tools.* Matt, intermediate teacher
>
> *[For] kids who struggle with writing it could be a real asset, I want to delve more into this and do more.* Jennifer, primary teacher

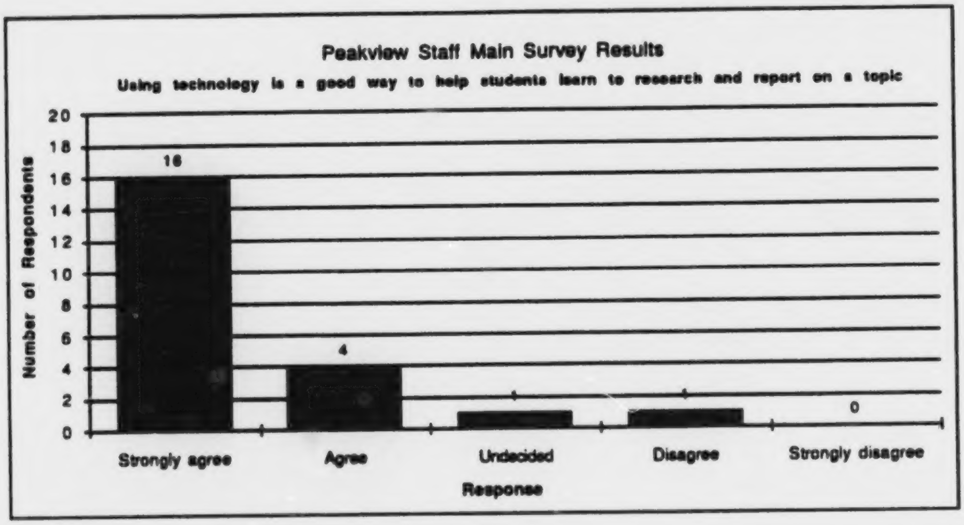
We could find little direct evidence that technology assisted students' development of oral communication skills. Some students narrated special *HyperCard* stacks at Peakview or *HyperStudio* stacks at Summit. However, these special projects are not done by all the students.

In summary, the high access to technology at Peakview appears to have a positive impact on students' written communication skills. Students have access to tools that help them edit their writing, check their spelling, and add pictures and sounds to their work. In general, teachers at Peakview report improvements in students' writing processes. The use of computers as writing *tools* was stressed by both students and teachers. There is preliminary evidence of learning benefits in the areas of spelling, grammar, and vocabulary.

## Researching and Reporting

The Staff Main Survey indicated that 20 of 22 (91%) staff members at Peakview agree that using technology is a good way to help students learn to research and report on a topic, with general agreement at all 4 schools (Figure 59).


Staff Main Survey Results
Using technology is a good way to help students learn to research and report on a topic
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
Using technology is a good way to help students learn to research and report on a topic
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
16
4
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

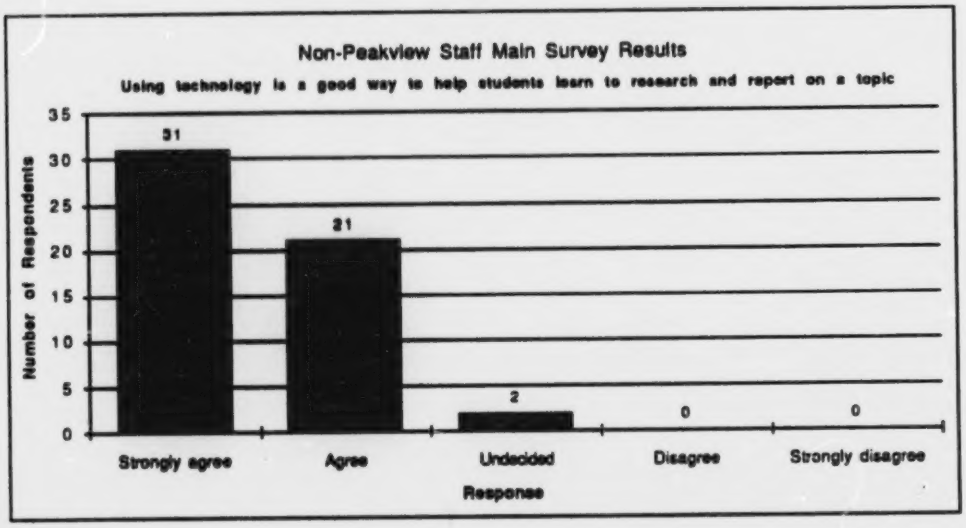

Non-Peakview Staff Main Survey Results
Using technology is a good way to help students learn to research and report on a topic
Number of Respondents
35
30
25
20
15
10
5
0
31
21
2
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 59.

Peakview teachers commented during interviews on students' independence in doing research:

> *More students are producing projects/reports/presentations using technology.* Teacher response to Main Survey
>
> *It's not uncommon, if the kids are researching a topic, to say, "May I go to the media center to get this resource, to watch this lasersdisc", etc. This is much different than the way it was in the past.* Robert
>
> *More movement, more independence doing research.* Matt, intermediate teacher
>
> *As the year has progressed, there are children who are not only writing but using multimedia for research. As a first/second grade teacher I found that hard to believe at the beginning of the year but am currently watching it occur with great success.* Charlotte, primary teacher

For grades 3-5, Peakview students, 96% agreed that technology is a good way to learn something new (Figure 60). Intermediate students in all four schools generally agreed, although the Peakview group differed sharply in the intensity of their response ($\chi^2=22.67$, $p<.001$). The Primary Focus Interviews indicated unanimous agreement across the four schools for the same statement (see Figure 61).

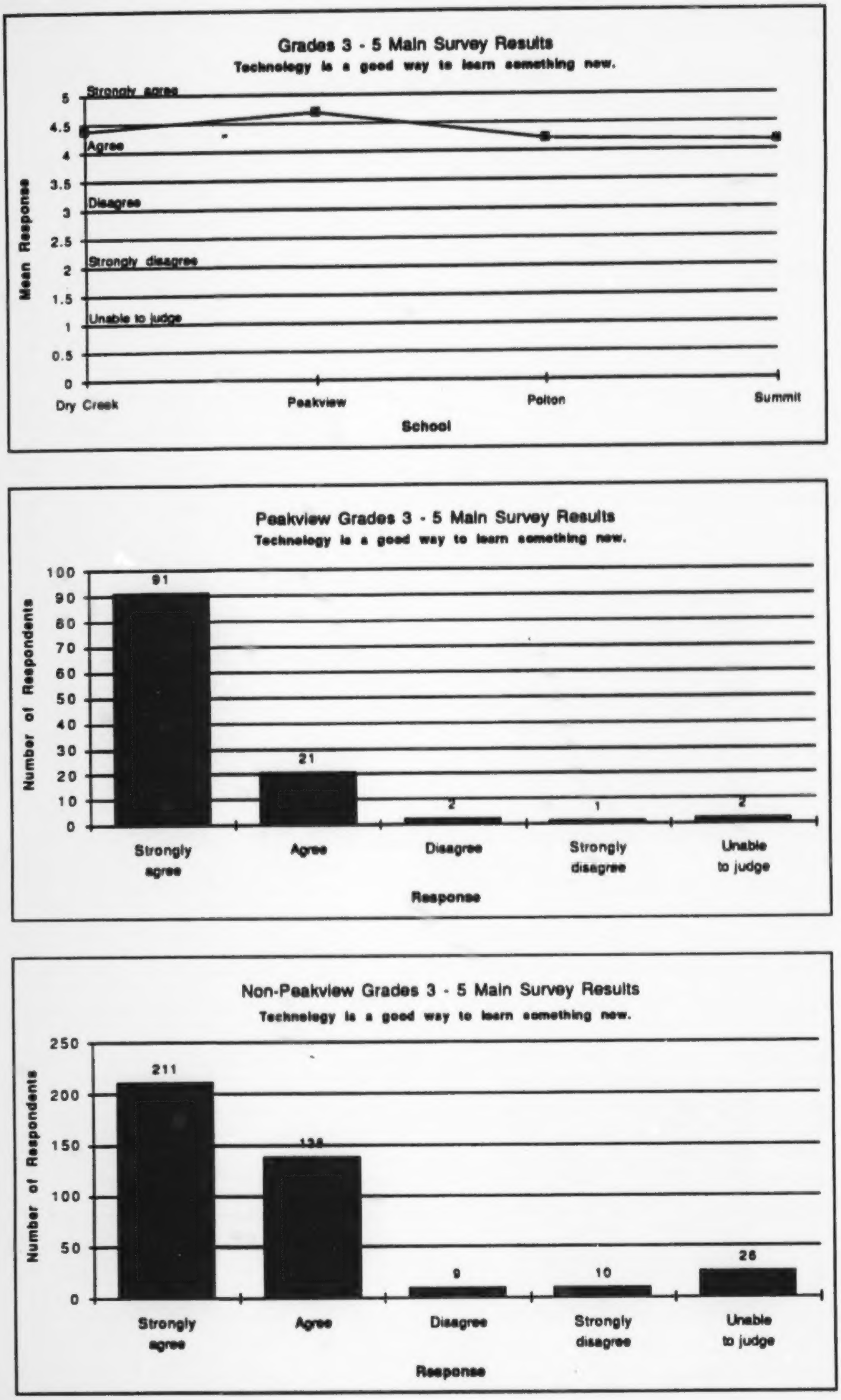
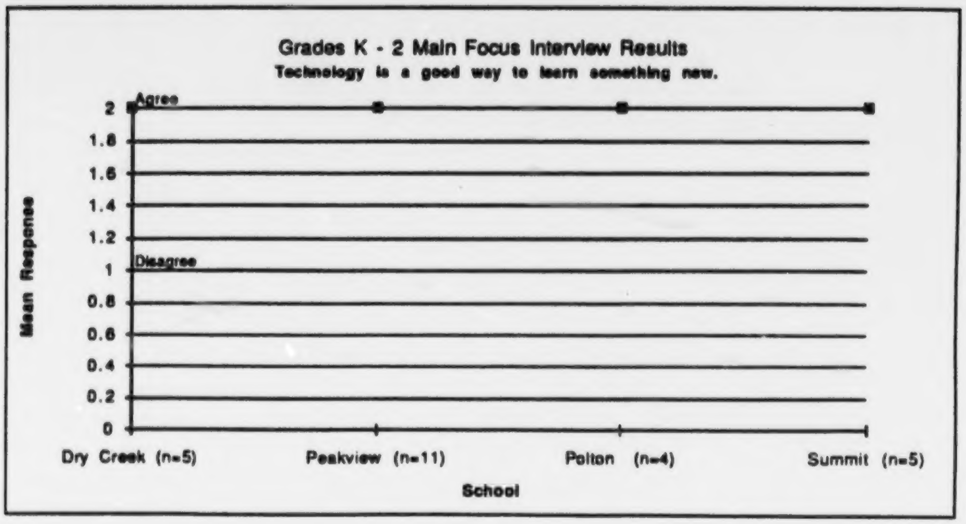
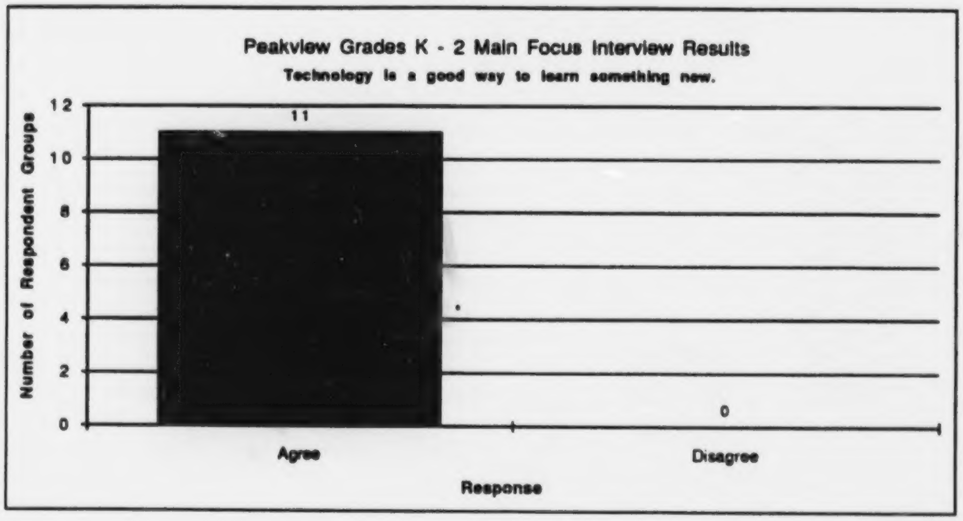

Grades 3 - 5 Main Survey Results
Technology is a good way to learn something new.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Dry Creek
Peakview
Polton
Summit
School
Peakview Grades 3 - 5 Main Survey Results
Technology is a good way to learn something new.
Number of Respondents
100
90
80
70
60
50
40
30
20
10
0
91
21
2
1
2
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response
Non-Peakview Grades 3 - 5 Main Survey Results
Technology is a good way to learn something new.
Number of Respondents
250
200
150
100
50
0
211
138
9
10
28
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

Figure 60.


Grades K - 2 Main Focus Interview Results
Technology is a good way to learn something new.
Agree
Disagree
Mean Response
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dry Creek (n=5)
Peakview (n=11)
Polton (n=4)
Summit (n=5)
School


Peakview Grades K - 2 Main Focus Interview Results
Technology is a good way to learn something new.
Number of Respondent Groups
12
10
8
6
4
2
0
11
0
Agree
Disagree
Response

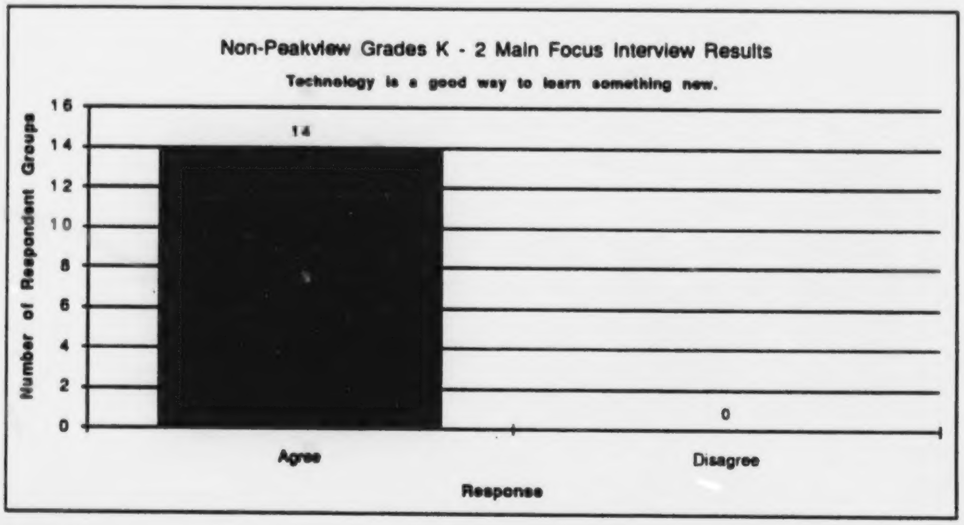

Non-Peakview Grades K - 2 Main Focus Interview Results
Technology is a good way to learn something new.
Number of Respondent Groups
16
14
12
10
8
6
4
2
0
14
0
Agree
Disagree
Response

Figure 61.

Peakview students describe their independent projects during interviews:

> *[My biggest project] was probably my explorer report, it was about Francisco Pizzaro. I wrote all the stuff on the computer. I scanned pictures in. I used the Visual Almanac to find out stuff about him. It was on The Writing Center. I put a lot of work into it.* Billy
>
> *What I'm doing right now is a project on dolphins using laserdiscs. Also, HyperCard for poetry... two of my biggest projects.* Jonathan
>
> *Like, the Tongue Twister stack, using HyperCard. It was about tongue twisters...words that are hard to say... I used the laserdisc and put some pictures into my stack.* Chad
>
> *For reports. I use it to find information. Pictures to help me if I find word, like armadillo, and I don't know what it is, I can look it up and it'll show you what it is.* Curt
>
> *[My favorite project was] my eagles project. It's a HyperCard stack that has a button on it to play the laserdisc. It has cards about wings, the body, and at the end some words you may want to know about the bald eagle.* Brandan

As observers in the school, the research team quickly noted the schools' emphasis on quality products. Student activity is often observed to be centered around projects. Pride in originality and creativity is evidenced by both student and staff. Weekly faculty meetings included a sample of student work with technology presented by the student(s) that produced it. Teachers report greater student interest and initiative in completing research projects when technology is used; this is especially pronounced at Peakview.

## The Student's Perspective

Students also have an opinion about what helps their learning. Students from all 4 schools were asked how much technology helped them learn. All grades and all schools responded "a lot" (Figures 62 and 63).

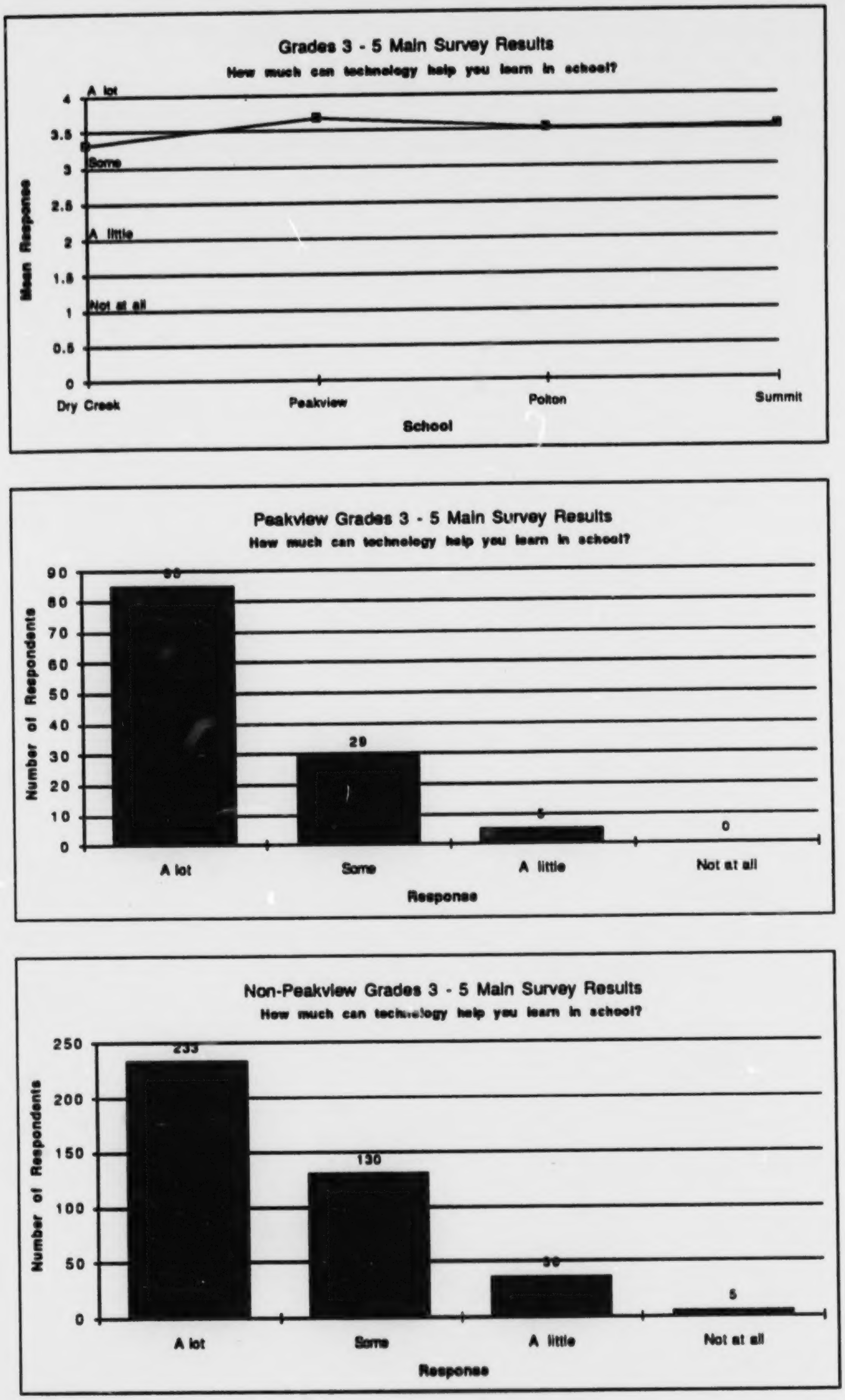
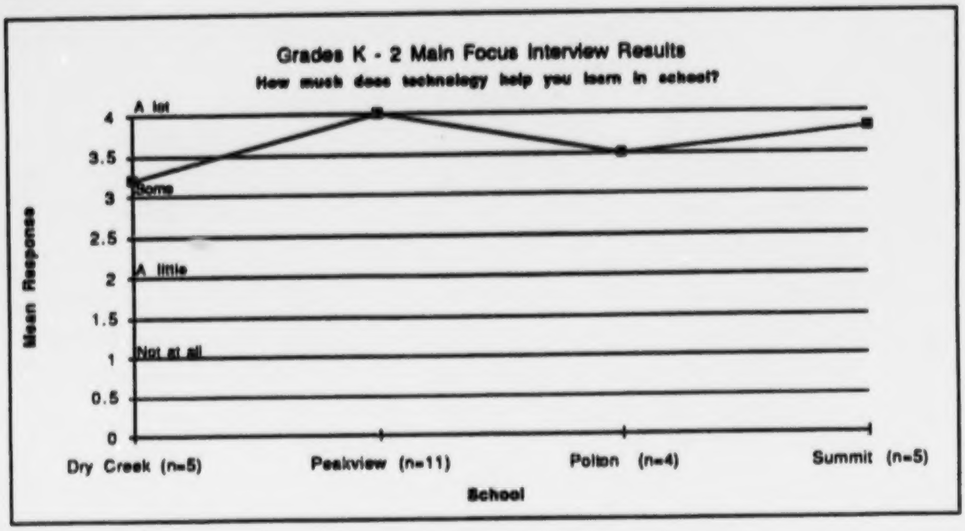
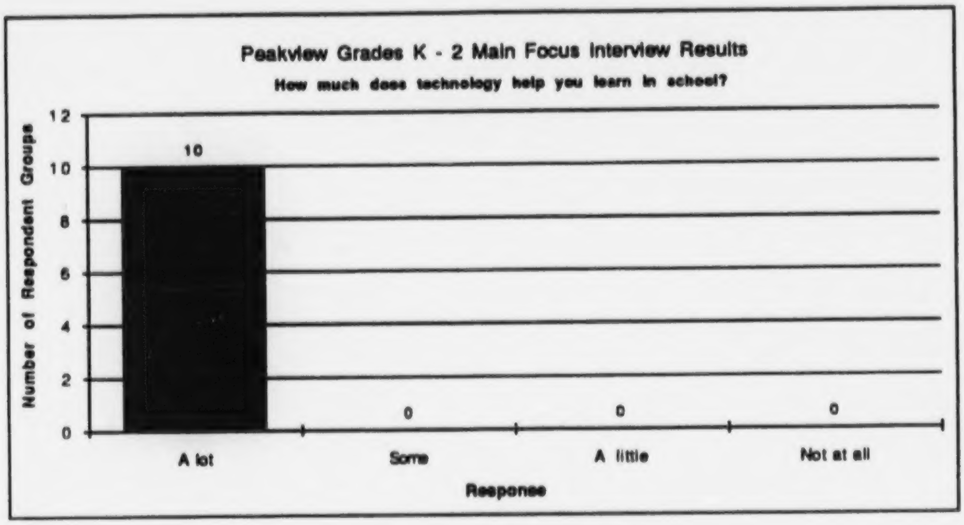

Grades 3 - 5 Main Survey Results
How much can technology help you learn in school?
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
A lot
Some
A little
Not at all
Dry Creek
Peakview
Polton
Summit
School
Peakview Grades 3 - 5 Main Survey Results
How much can technology help you learn in school?
Number of Respondents
90
80
70
60
50
40
30
20
10
0
29
5
0
A lot
Some
A little
Not at all
Response
Non-Peakview Grades 3 - 5 Main Survey Results
How much can technology help you learn in school?
Number of Respondents
250
200
150
100
50
0
233
130
5
A lot
Some
A little
Not at all
Response

Figure 62.


Grades K - 2 Main Focus Interview Results
How much does technology help you learn in school?
Mean Response
4
3.5
3
2.5
2
1.5
1
0.5
0
A lot
Some
A little
Not at all
Dry Creek (n=5)
Peakview (n=11)
Polton (n=4)
Summit (n=5)
School


Peakview Grades K - 2 Main Focus Interview Results
How much does technology help you learn in school?
Number of Respondent Groups
12
10
8
6
4
2
0
10
0
0
0
A lot
Some
A little
Not at all
Response

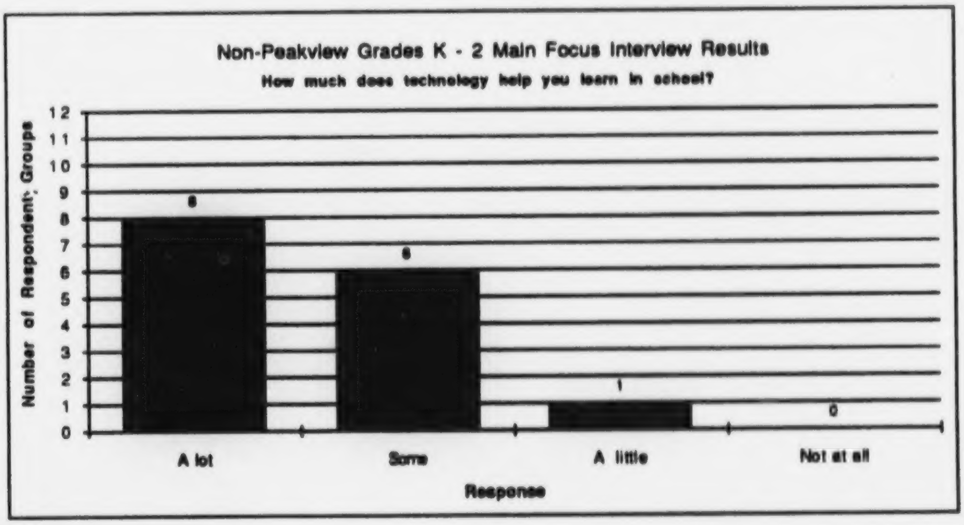
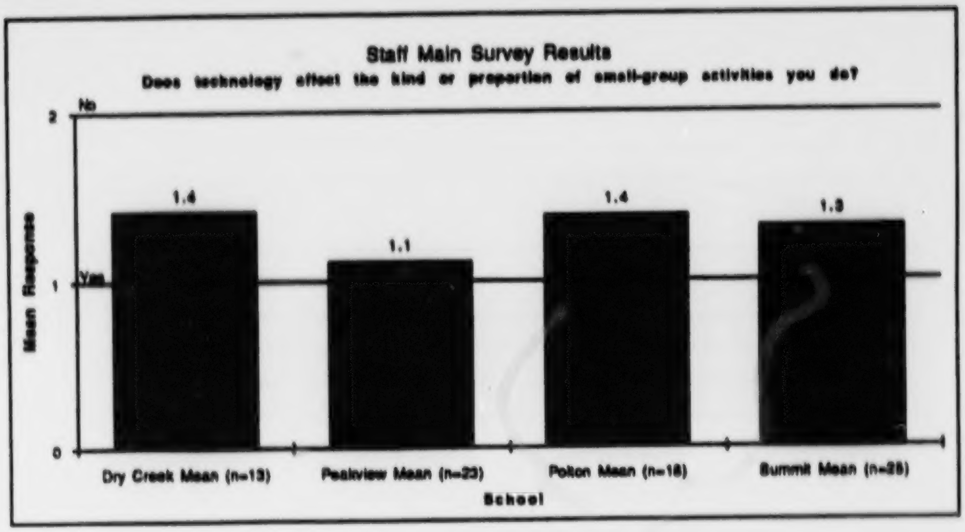
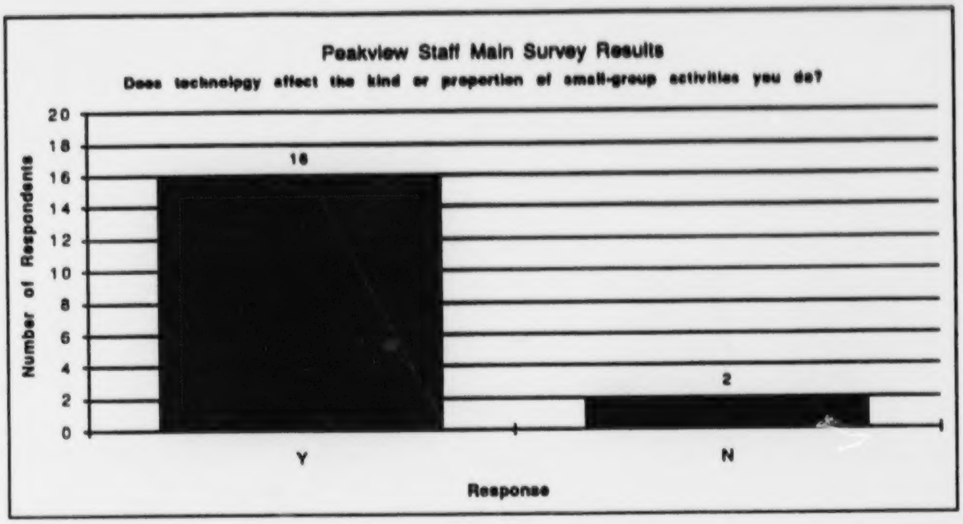

Non-Peakview Grades K - 2 Main Focus Interview Results
How much does technology help you learn in school?
Number of Respondent Groups
12
11
10
9
8
7
6
5
4
3
2
1
0
8
6
1
0
A lot
Some
A little
Not at all
Response

Figure 63.

## Small-group Work

Figure 64 indicates that technology at Peakview affects the way most staff members use small-group activities. Peakview teachers tend to use small-group activities significantly more (F=4.94, $p<.05$) than non-Peakview teachers. Most staff members at Peakview (19 out of a sample of 23) agree that technology is a good way to help students learn to work in small groups (Figure 65). All staff members in the Peakview sample agree that technology can enhance social interaction between students (Figure 66), with Peakview teachers differing significantly from non-Peakview teachers ($\chi^2=13.62$, $p<.01$). Conversely, 20 of 23 Peakview staff disagree that technology tends to isolate students from each other (see Figure 67). This effect was also statistically significant ($\chi^2=13.44$, $p<.01$).


Staff Main Survey Results
Does technology affect the kind or proportion of small-group activities you do?
2
No
1
Yes
0
Mean Response
1.4
1.1
1.4
1.3
Dry Creek Mean (n=13)
Peakview Mean (n=23)
Polton Mean (n=18)
Summit Mean (n=25)
School


Peakview Staff Main Survey Results
Does technolpgy affect the kind or proportion of small-group activities you do?
20
18
16
14
12
10
8
6
4
2
0
Number of Respondents
16
2
Y
N
Response

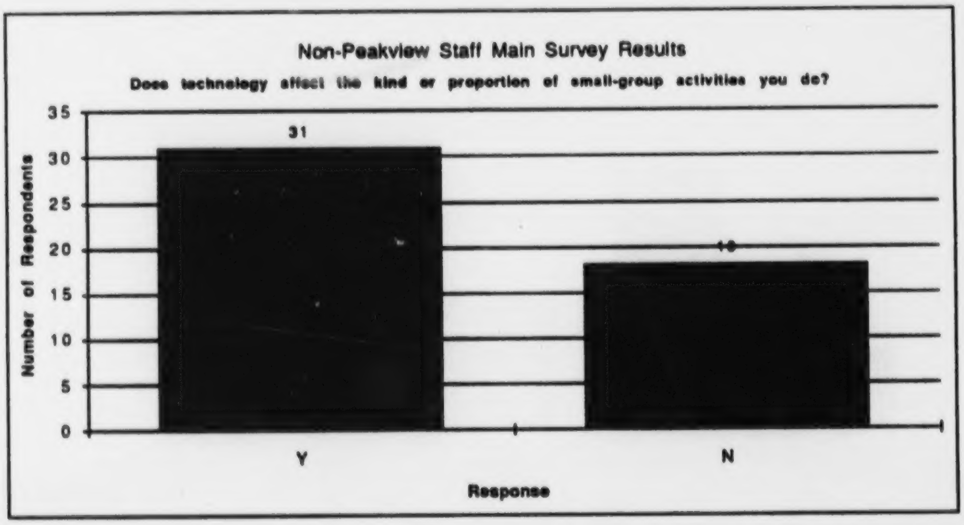

Non-Peakview Staff Main Survey Results
Does technology affect the kind or proportion of small-group activities you do?
35
30
25
20
15
10
5
0
Number of Respondents
31
18
Y
N
Response

Figure 64.

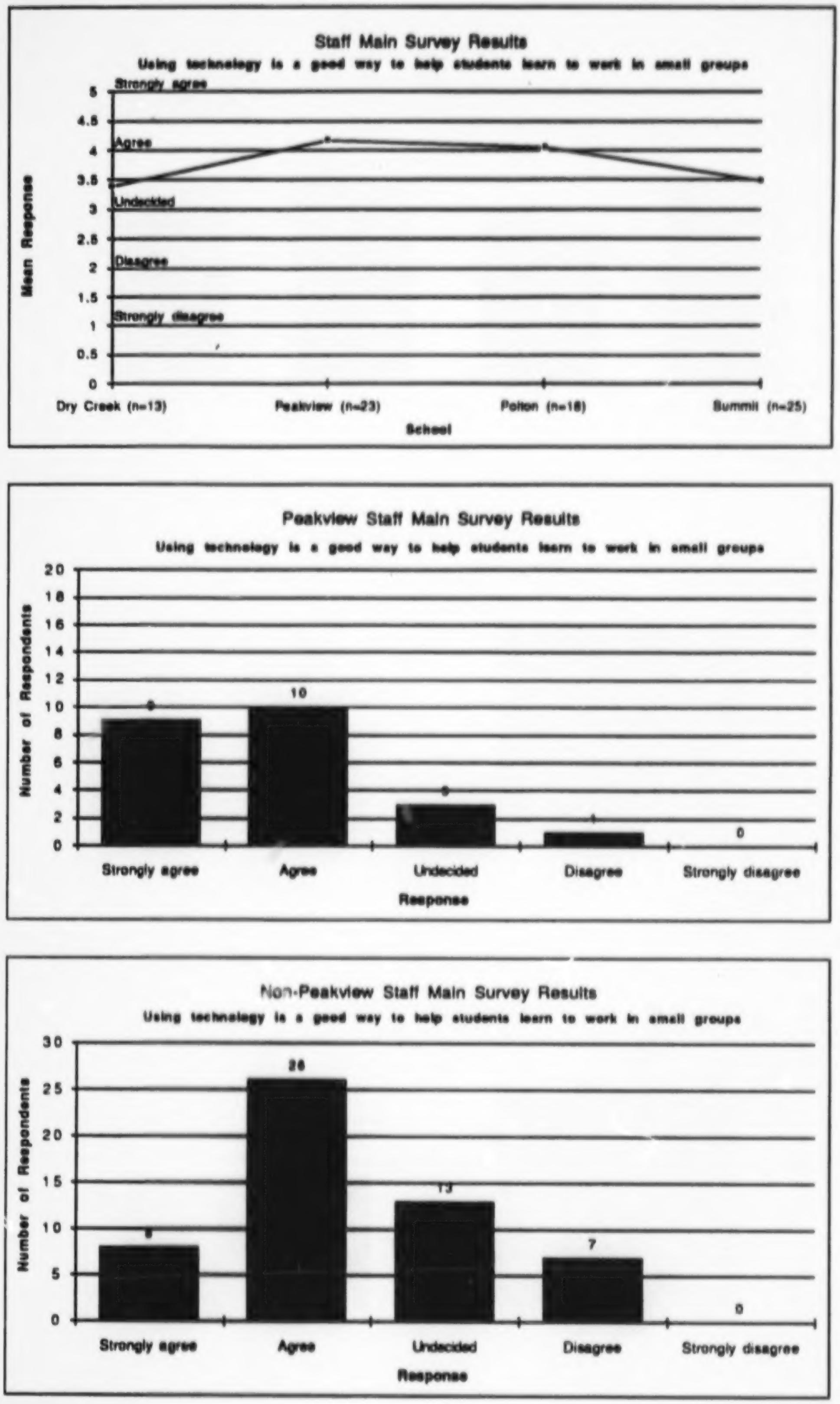

Staff Main Survey Results
Using technology is a good way to help students learn to work in small groups
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Using technology is a good way to help students learn to work in small groups
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
9
10
3
1
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response
Non-Peakview Staff Main Survey Results
Using technology is a good way to help students learn to work in small groups
Number of Respondents
30
25
20
15
10
5
0
8
26
13
7
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 65.

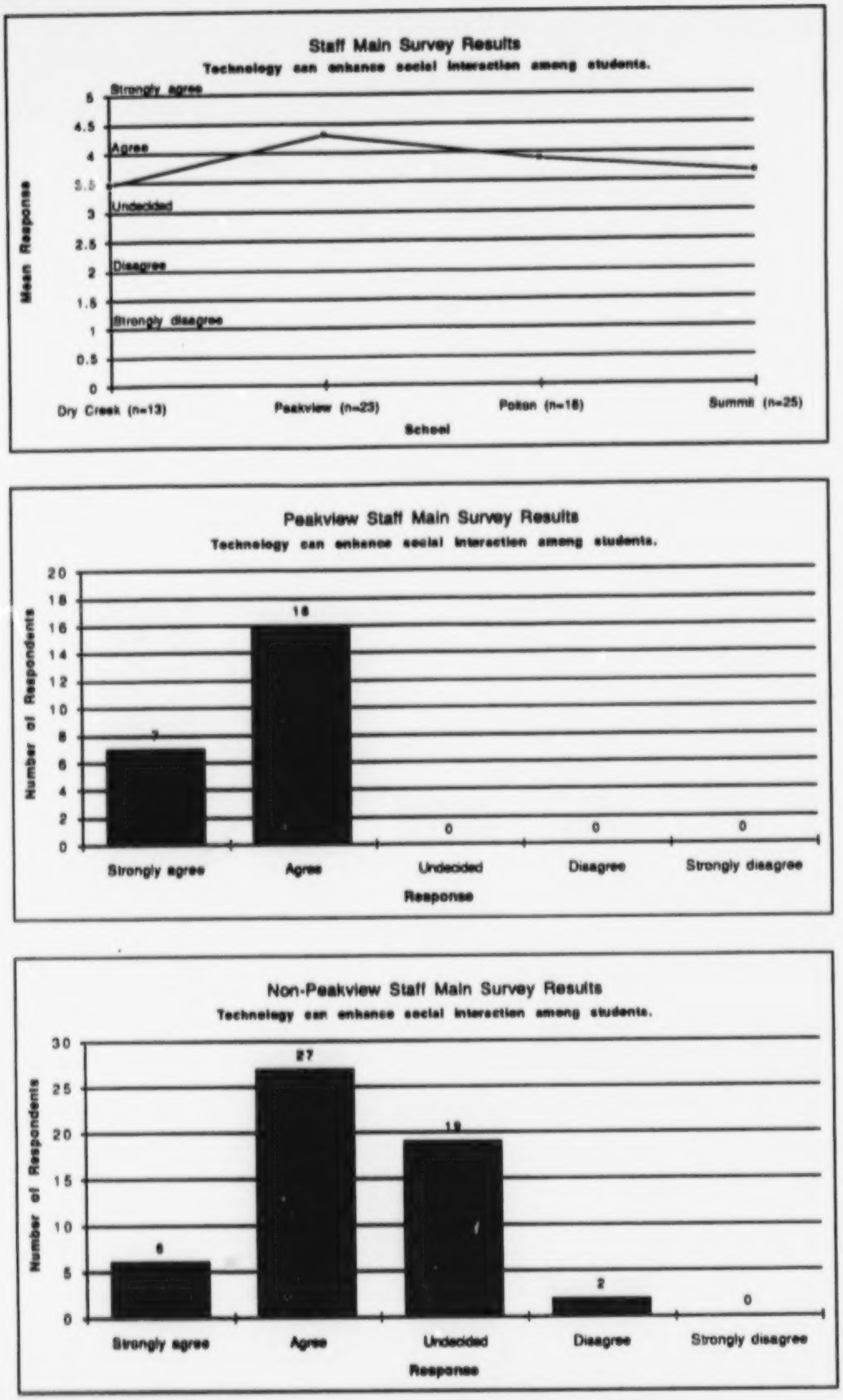

Staff Main Survey Results
Technology can enhance social interaction among students.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Dry Creek (n=13)
Peakview (n=23)
Pokon (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Technology can enhance social interaction among students.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
7
16
0
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response
Non-Peakview Staff Main Survey Results
Technology can enhance social interaction among students.
Number of Respondents
30
25
20
15
10
5
0
6
27
19
2
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 66.

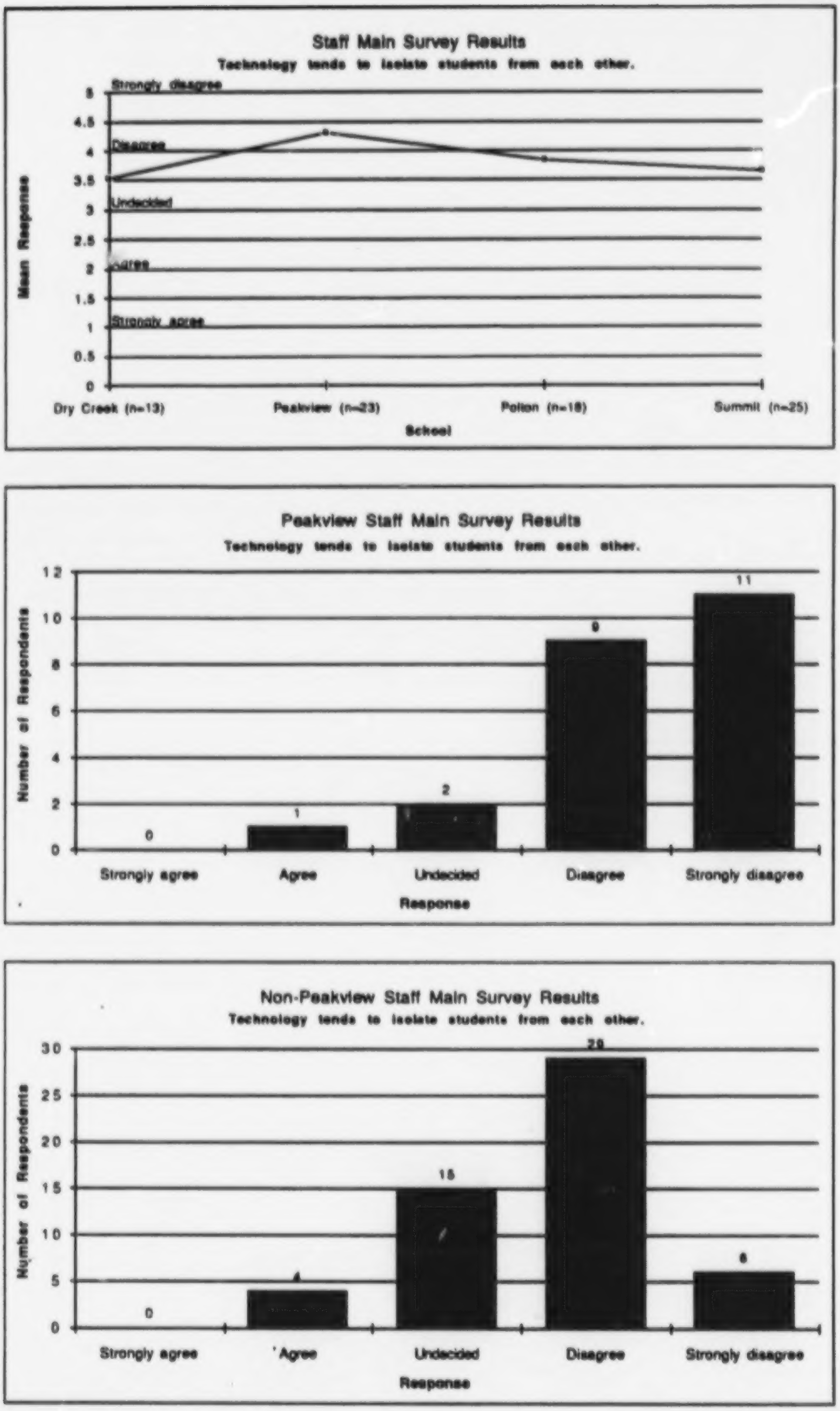

Staff Main Survey Results
Technology tends to isolate students from each other.
Mean Response
Strongly disagree
Disagree
Undecided
Agree
Strongly agree
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Technology tends to isolate students from each other.
Number of Respondents
12
10
8
6
4
2
0
0
1
2
9
11
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response
Non-Peakview Staff Main Survey Results
Technology tends to isolate students from each other.
Number of Respondents
30
25
20
15
10
5
0
0
4
15
29
6
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 67.

From the survey responses, Peakview teachers appear more sanguine about the social effects of technology. Peakview faculty interviews confirm this positive perception:

> *I've seen a tremendous burst of cooperative learning because of computers.* Nora, Kindergarten teacher
>
> *One computer for every two students would maybe be ideal.* Matt, intermediate teacher
>
> *I would like one for each kid, or one computer per pair.* Adam, intermediate teacher
>
> *They learn to depend on each other and to seek each other out a lot more. That independence carries over to other things. It's OK to know more or less or different [things] than other kids. We all have different talents and we share them. It's OK to know things that your teacher doesn't know. [They have a] sense of control over their own learning. Cooperative learning is enhanced because the nature of the computers and available guides requires that they help each other... there's not enough adults.* Lynn, primary teacher

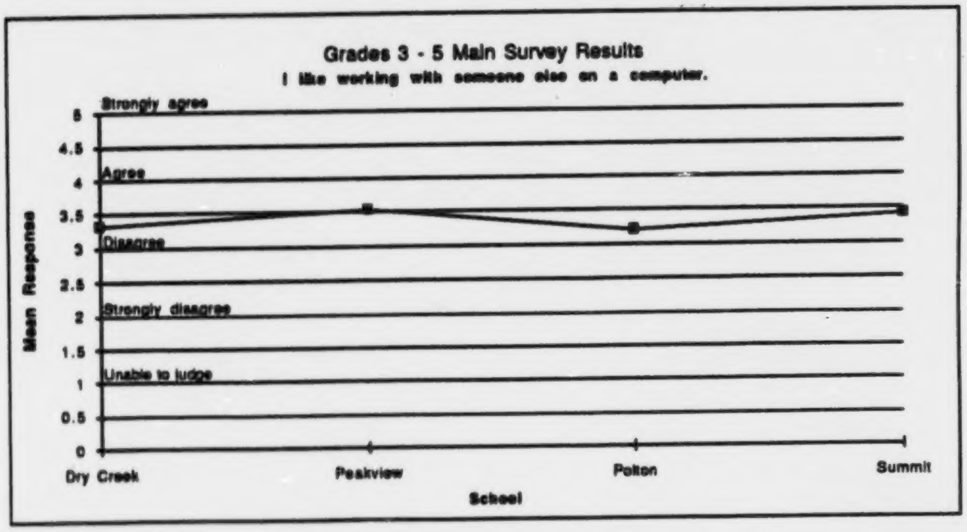
In spite of faculty optimism about cooperative learning, the students themselves are mixed in their attitudes toward using technology in groups. Figures 14 and 15 show students reactions to the statement, *I like working with someone else on a computer.* A majority of intermediate students (Figure 68), both Peakview and non-Peakview, agree that they like working with someone else on a computer. Primary students report a stronger agreement with the statement (Figure 69). Responses to this question suggest a willingness to work with others.

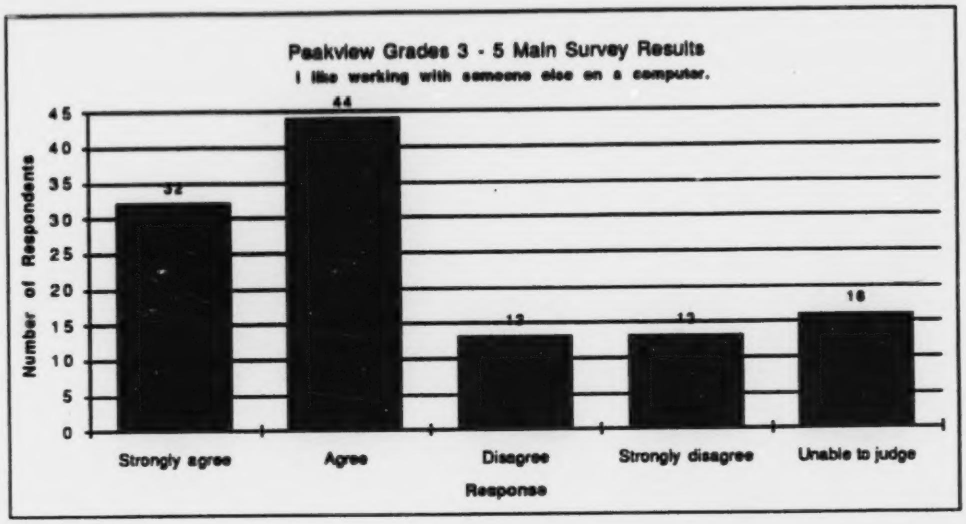
However, another question presents a somewhat different picture of student preferences. Students were asked to rank order their preferences for using technology individually or in various group sizes. Intermediate students at all four schools chose the following rank order (percentages in Table 13 indicate the relative strength of the choice when treated as a separate question):

**Intermediate Students**

| | | Peakview Students | Non-Peakview Students |
|---|---|---|---|
| Favorite: | By Myself | 67%, N=117 | 64%, N=403 |
| Second Favorite: | Group of 2–3 | 32%, N=117 | 32%, N=393 |
| Third Favorite: | Group 0f 4–6 | <1%, N=117 | 2%, N=386 |
| Least Favorite: | Whole Class | <1%, N=116 | 3%, N=392 |

Table 13. *Intermediate student preferences for using technology.*


Grades 3 - 5 Main Survey Results
I like working with someone else on a computer.
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek
Peakview
Polton
Summit
School


Peakview Grades 3 - 5 Main Survey Results
I like working with someone else on a computer.
Number of Respondents
45
40
35
30
25
20
15
10
5
0
32
44
13
13
16
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

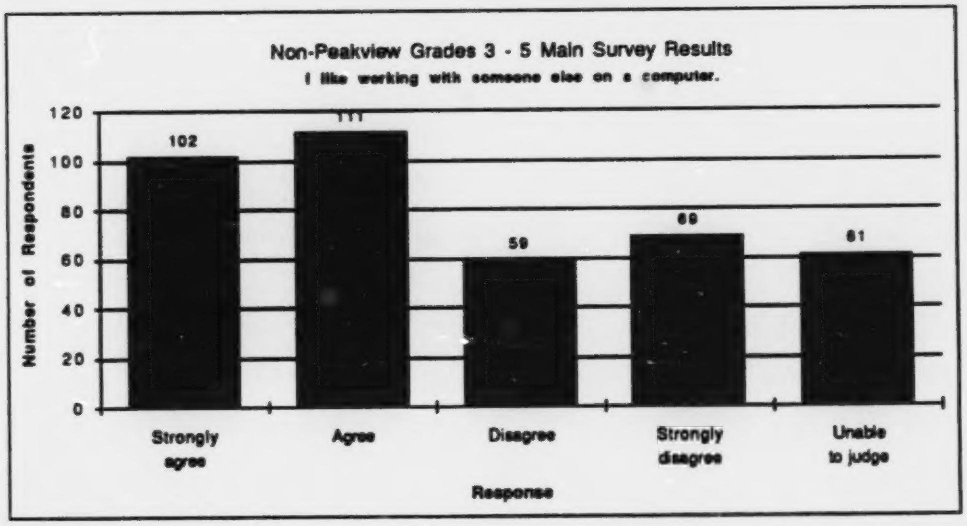

Non-Peakview Grades 3 - 5 Main Survey Results
I like working with someone else on a computer.
Number of Respondents
120
100
80
60
40
20
0
102
111
59
69
61
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

Figure 68.

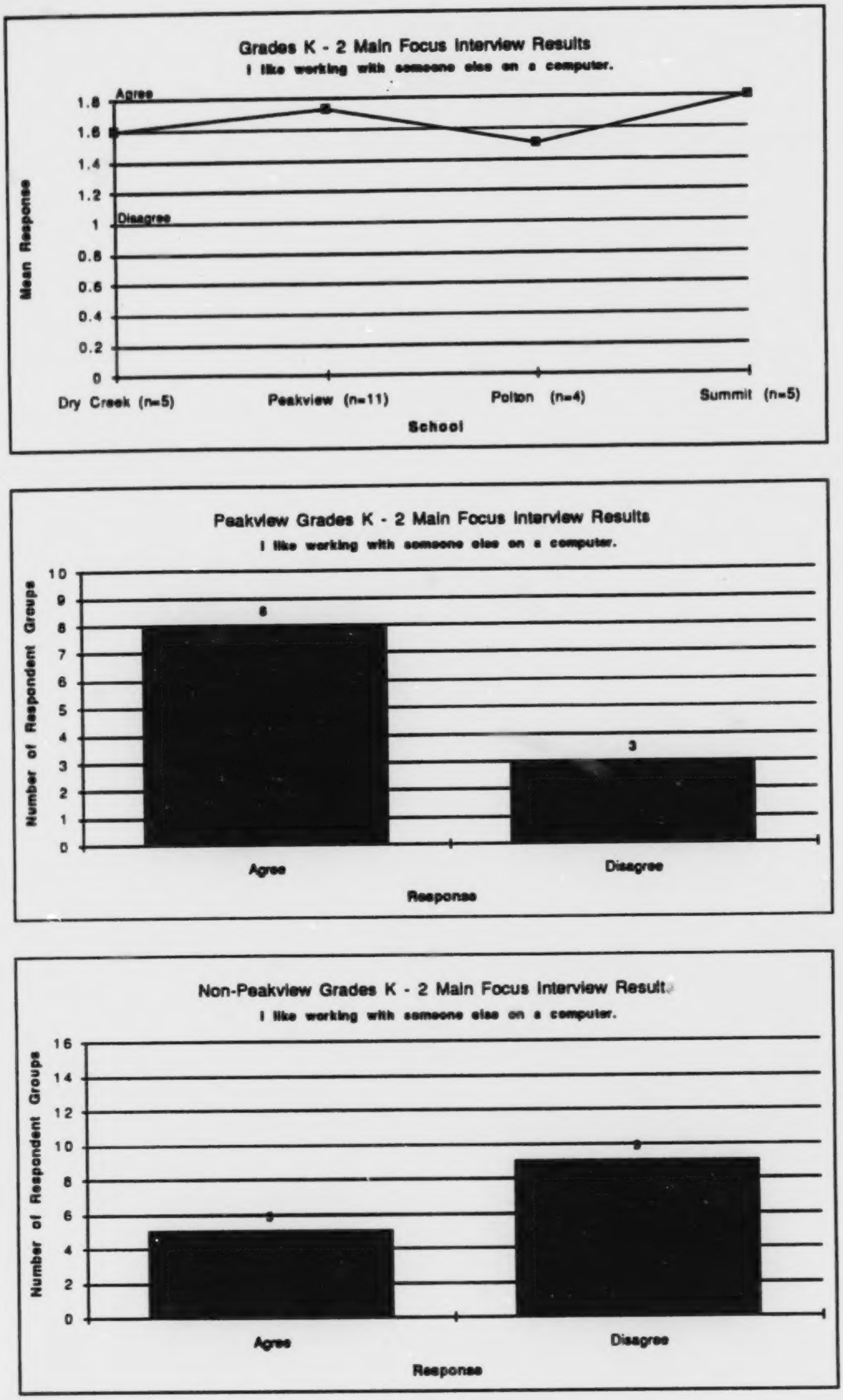

Grades K - 2 Main Focus Interview Results
I like working with someone else on a computer.
Agree
Disagree
Mean Response
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dry Creek (n=5)
Peakview (n=11)
Polton (n=4)
Summit (n=5)
School
Peakview Grades K - 2 Main Focus Interview Results
I like working with someone else on a computer.
Number of Respondent Groups
10
9
8
7
6
5
4
3
2
1
0
8
3
Agree
Disagree
Response
Non-Peakview Grades K - 2 Main Focus Interview Results
I like working with someone else on a computer.
Number of Respondent Groups
16
14
12
10
8
6
4
2
0
5
9
Agree
Disagree
Response

Figure 69.

The Primary Survey also asked groups of primary students at Peakview to rank the following personal choices for technology use: Alone, In Groups of 2–3, In Groups of 4–6, or With the Whole Class. The survey data indicated that the primary students at Peakview chose the same rank order as the intermediate students (see Table 14 below).

**Primary Students**

| | | Peakview Students | Non-Peakview Students |
|---|---|---|---|
| Favorite: | By Myself | 70%, N=10 | 67%, N=12 |
| Second Favorite: | Group of 2–3 | 22%, N=9 | 66%, N=12 |
| Third Favorite: | Group of 4–6 | 0%, N=7 | 0%, N=8 |
| Least Favorite: | Whole Class | 14%, N=7 | 0%, N=8 |

Table 14. *Primary student preferences for using technology.*

Interviews with Peakview students (see transcriptions in Appendix C) suggested that a preference for working alone usually centered around a desire for independence. Twelve of 23 (52%) of Peakview students interviewed mentioned positive benefits for working alone. Comments in favor of working with a partner or partners related to the ability to learn from others, help others, or share ideas (14 of 23 or 61% of Peakview students interviewed said that they benefit from working with a partner). For example, one student remarked:

> *If it's something I know pretty well, I like to do it by myself. But if it's something new, I prefer working with a partner.* Lindsay
>
> *[I prefer working alone] because you don't have anyone to boss you around.* Kyra
>
> *Most of the time I like working alone, but I wouldn't mind working with a partner cause they can help me and I can help them. When I'm doing a report for a good, good grade, I'd prefer working by myself. Also, when I've had a real bad week I prefer working by myself. When I have a good partner, or when I've had a good week, I like having a partner. One time this kid had no idea how to get out of this writing thing, and he didn't want to delete his whole story, so I showed him how he [should] do it. He was happy; he said thanks and everything.* Curt
>
> *[I like] having a partner when I'm doing a report and there's two sections to it, and one person can write one part and the other person writes the other.* Billy
>
> *[I like to work] alone. Because I like to learn by myself. It's sort of crowded when you have partners. Sometimes I do like partners 'cause we could work on something that's like a mystery, and we could figure it out together. If I'm doing some kind of problem solving thing I like having a partner.* Jeff
>
> *[I don't]...like people telling me what to do with writing. On games and stuff*

*[But]...it's more fun with a friend...and math.* Matthew

*I prefer working alone. I don't like to work with people because they stress me out. Sometimes they vote against me and that stresses me. My dream is to have a private computer at school that would have my name on it.* Elizabeth

An interesting comparison to the above data on student preferences is how students perceived the way they actually use technology on a day-to-day basis. In the Intermediate Survey, Peakview students were asked, *Do you usually use technology alone or with other people?* The following table synthesizes the response pattern of intermediate students.

**Peakview Intermediate Students**

| Do you use technology: | Usually | Sometimes | Hardly Ever |
|---|---|---|---|
| By myself (N=116) | 64% | 29% | 7% |
| In Groups of 2 to 3 (N=114) | 11% | 54% | 34% |
| In Groups of 4 to 6 (N=113) | 4% | 12% | 84% |
| With the Whole Class (N=115) | 6% | 42% | 52% |

Table 15. *Frequency of working along and in groups from the Main Survey.*

Not surprisingly, Peakview intermediate students report using technology alone more than non-Peakview students ($\chi^2=11.22$, $p<.01$). They also report more whole-class uses of technology ($\chi^2=24.83$, $p<.001$). These differences are likely attributable to greater access to various technologies at Peakview.

In the Primary Focus Interview, students were asked the same question, with similar results. The following table synthesizes the data.

**Peakview Primary Students**

| Do you use technology: | Usually | Sometimes | Hardly Ever |
|---|---|---|---|
| Alone (N= 11) | 82% | 18% | 0% |
| In Groups of 2 to 3 (N=9) | 11% | 44% | 44% |
| In Groups of 4 to 6 (N=9) | 0% | 11% | 89% |
| With the Whole Class (N=9) | 11% | 56% | 33% |

Table 16. *Frequency of working along and in groups from the Main Survey.*

Thus students of both age groups report that day-to-day work with technology tends toward individualization, with occasional cooperative groupings of 2 or 3 students, and rare cooperative groupings of more than 3 students or whole class.

The impact of the technology on grouping can be summarized as follows:

1. Its presence does impact how students are grouped. Peakview teachers tend toward small groups versus whole-class activities.

2. In general, many students respond positively to small-group work; however, given a choice, most students prefer working alone with technology.

## Creativity

All 23 Peakview staff members agreed that using technology is a good way to enhance students' creativity (Figure 70). Also, all 23 Peakview staff members disagree that the use of technology degrades the quality of a student's education (Figure 71). This result was common across all schools. Twenty of 23 (87%) of Peakview staff members agree that kids who use technology in their early years will cope better in later years (Figure 72). Non-Peakview teachers responded similarly.

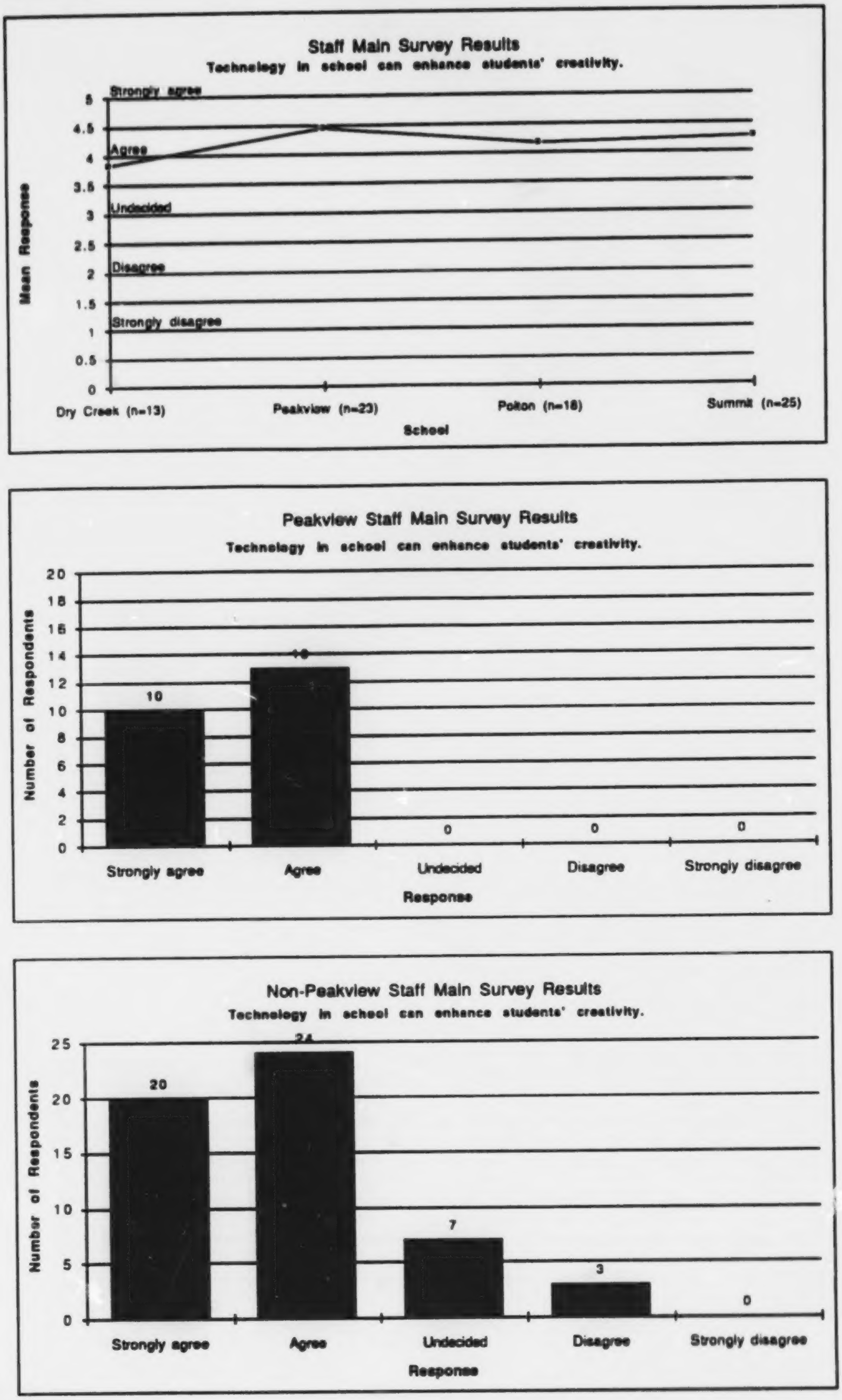
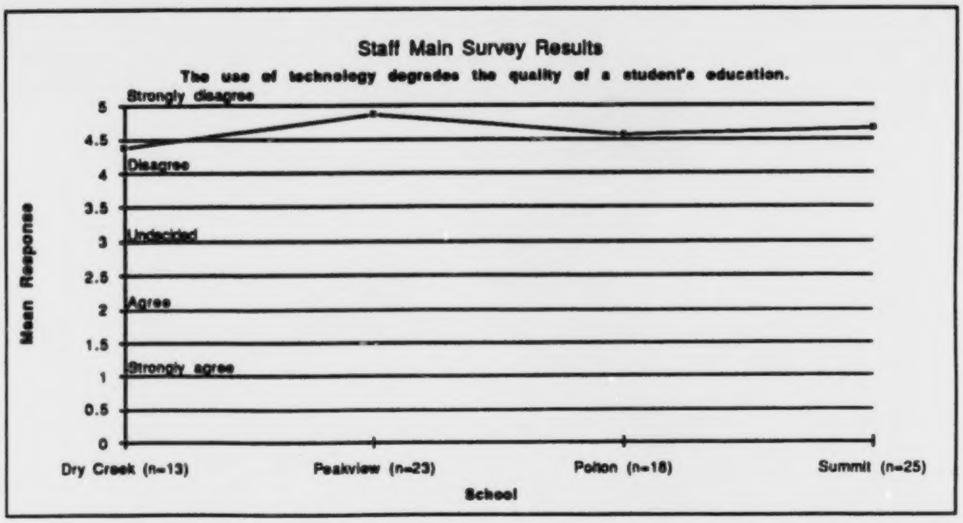
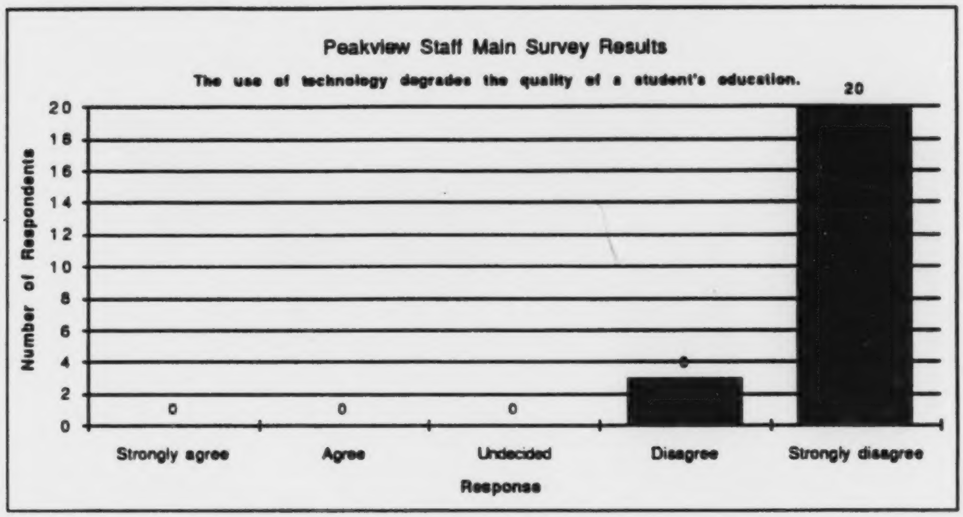

Staff Main Survey Results
Technology in school can enhance students' creativity.
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School
Peakview Staff Main Survey Results
Technology in school can enhance students' creativity.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
10
13
0
0
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response
Non-Peakview Staff Main Survey Results
Technology in school can enhance students' creativity.
Number of Respondents
25
20
15
10
5
0
20
24
7
3
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 70.


Staff Main Survey Results
The use of technology degrades the quality of a student's education.
Strongly disagree
Disagree
Undecided
Agree
Strongly agree
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
The use of technology degrades the quality of a student's education.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
0
0
0
3
20
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

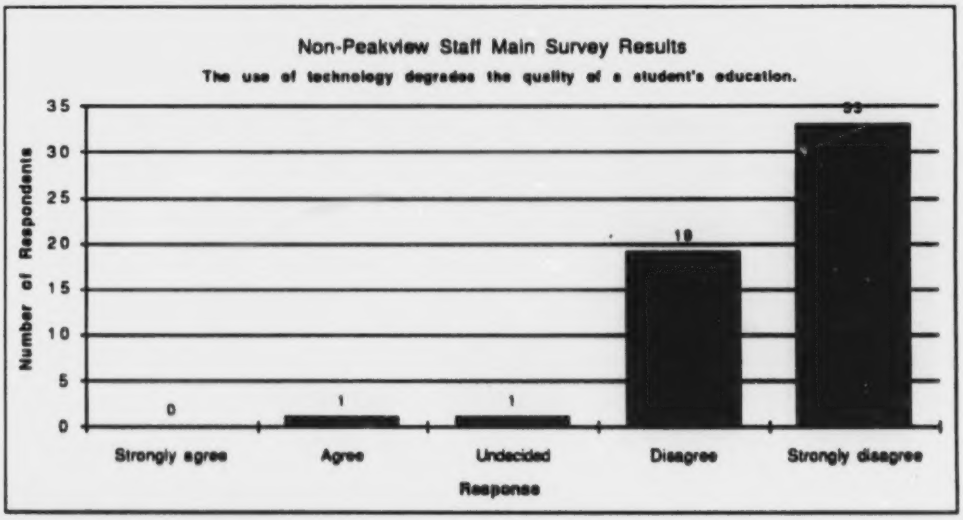
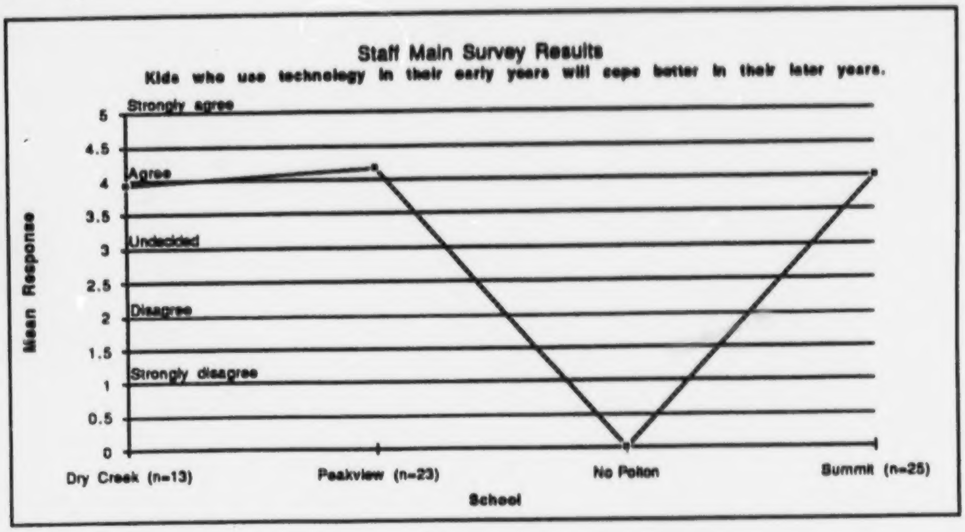
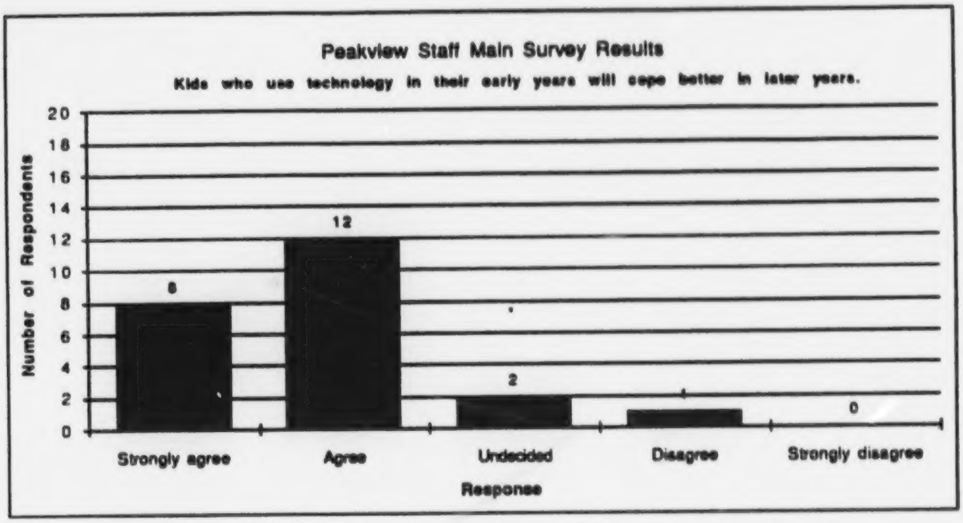

Non-Peakview Staff Main Survey Results
The use of technology degrades the quality of a student's education.
Number of Respondents
35
30
25
20
15
10
5
0
0
1
1
19
33
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 71.


Staff Main Survey Results
Kids who use technology in their early years will cope better in their later years.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Dry Creek (n=13)
Peakview (n=23)
No Polton
Summit (n=25)
School


Peakview Staff Main Survey Results
Kids who use technology in their early years will cope better in later years.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
8
12
2
1
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

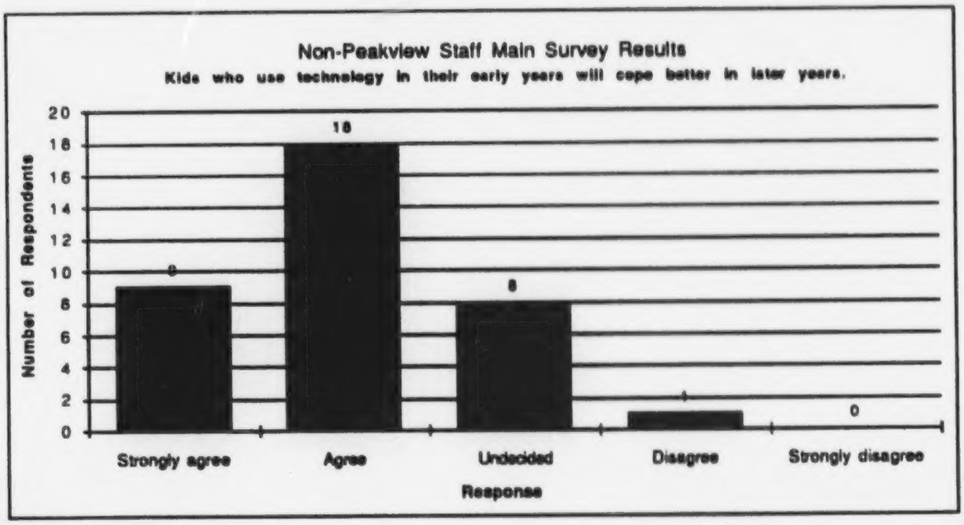

Non-Peakview Staff Main Survey Results
Kids who use technology in their early years will cope better in later years.
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
9
18
8
1
0
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 72.

Peakview teachers comment on creativity and technology:

> *It really gives kids a sense of power, particularly in the writing areas. For my little guys, when they can't necessarily control their motor skills, they can still communicate. They're more willing to take that risk and be creative.* Lynn, primary teacher
>
> *So many kids [who] hate drawing prefer Kidpix. It gives an opportunity to kids who really feel terrible about their drawing. They can still be creative and accomplish something they're proud of.* Kate, intermediate teacher

# Student Attitudes

In this section, we report on student attitudes toward school, toward the technology, and toward themselves.

## Attitudes Toward School

Peakview students expressed generally positive attitudes towards school. When asked in August about the difficulty of school, 75% of Peakview 5 graders and 63% of the K–2 graders responded "just right" (see Figure 73)

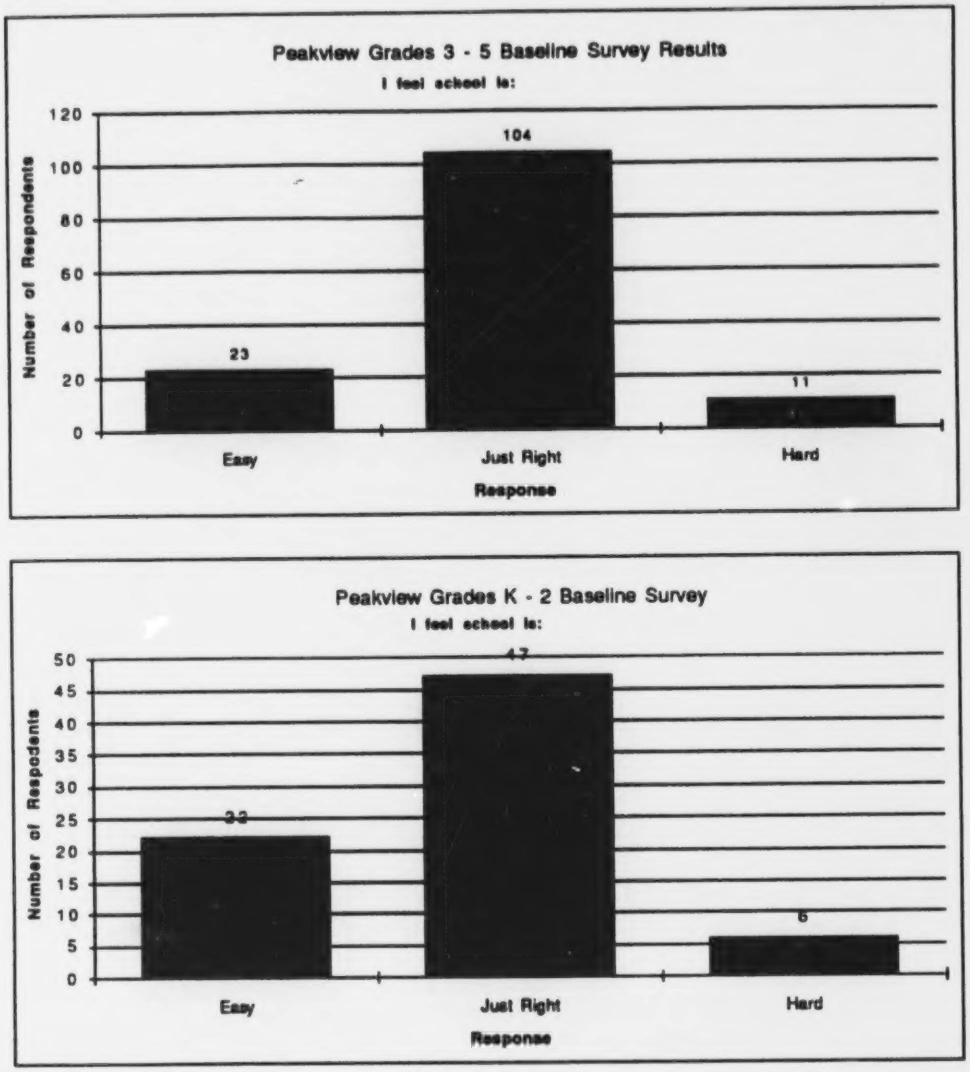


Figure 73.

Also in August, Peakview students of all grades agreed that using computers makes school "more fun" (Figure 74).

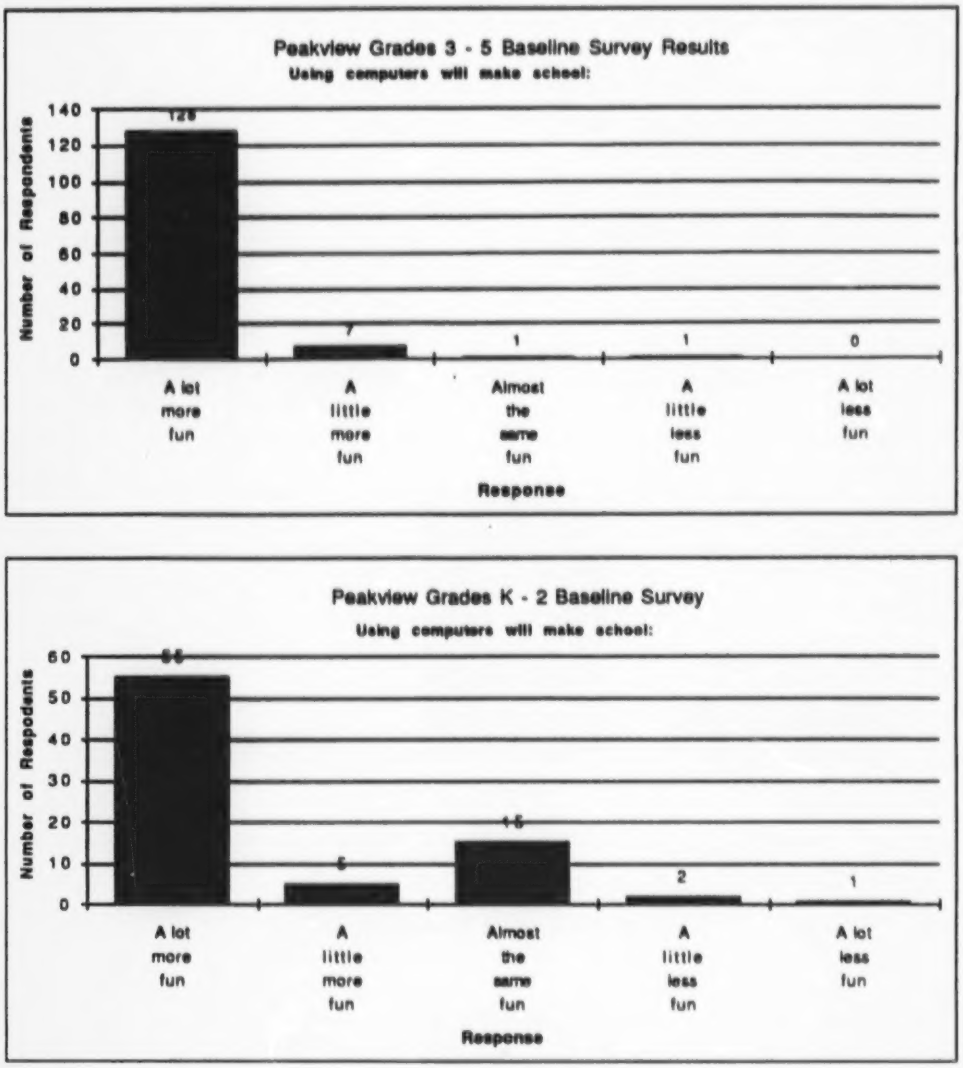
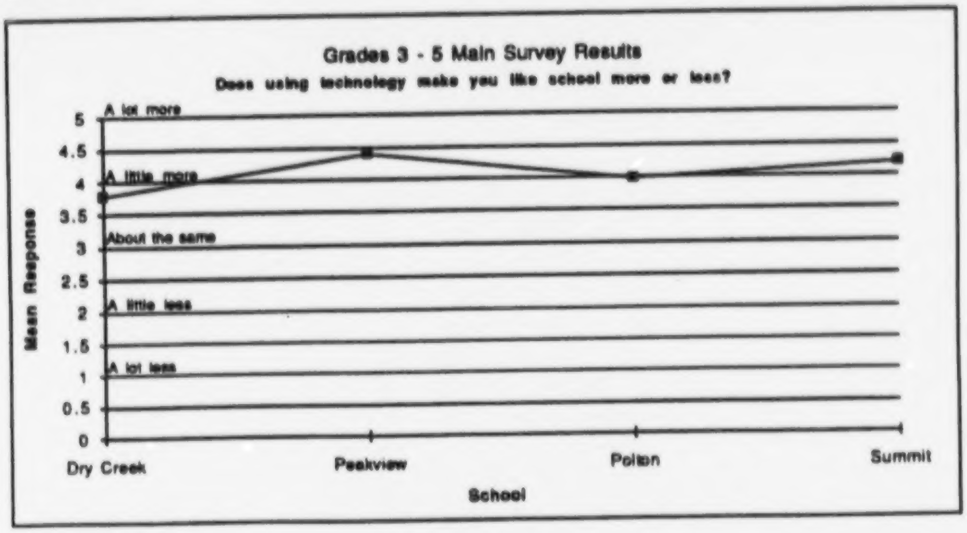


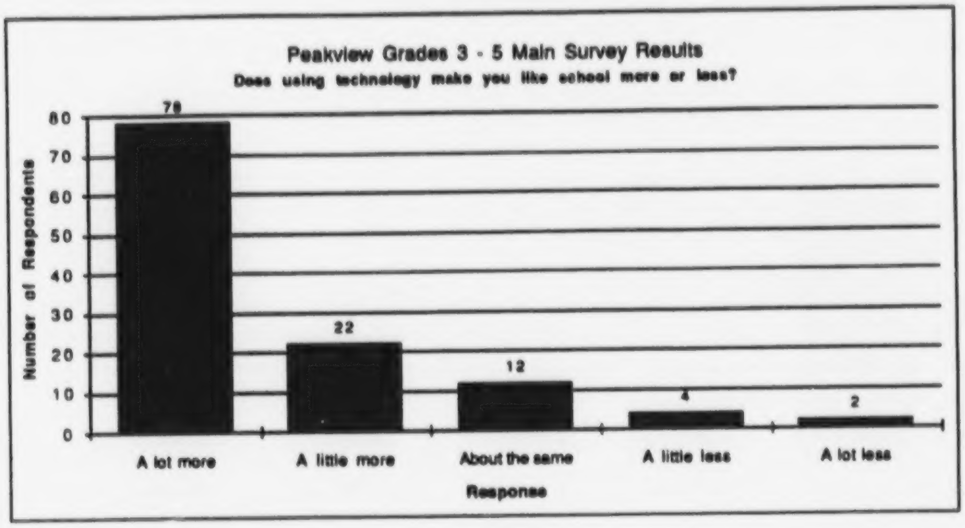
Figure 74.

When asked to describe school without technology, one student commented:

> *It would be boring. I wouldn't have that many good things to do. Cause some of our time is for using the computer and if we didn't do that we wouldn't have anything else to do.* Jeff

Students at all four schools reported liking school more because of the technology available (Figures 77 and 78). In intermediate grades, the response pattern of Peakview students differed sharply from non-Peakview students ($\chi^2$=30.16, p<.001), suggesting that technology plays a stronger role in children's positive attitudes toward school.


Grades 3 - 5 Main Survey Results
Does using technology make you like school more or less?
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
A lot more
A little more
About the same
A little less
A lot less
Dry Creek
Peakview
Polton
Summit
School


Peakview Grades 3 - 5 Main Survey Results
Does using technology make you like school more or less?
Number of Respondents
80
70
60
50
40
30
20
10
0
78
22
12
4
2
A lot more
A little more
About the same
A little less
A lot less
Response

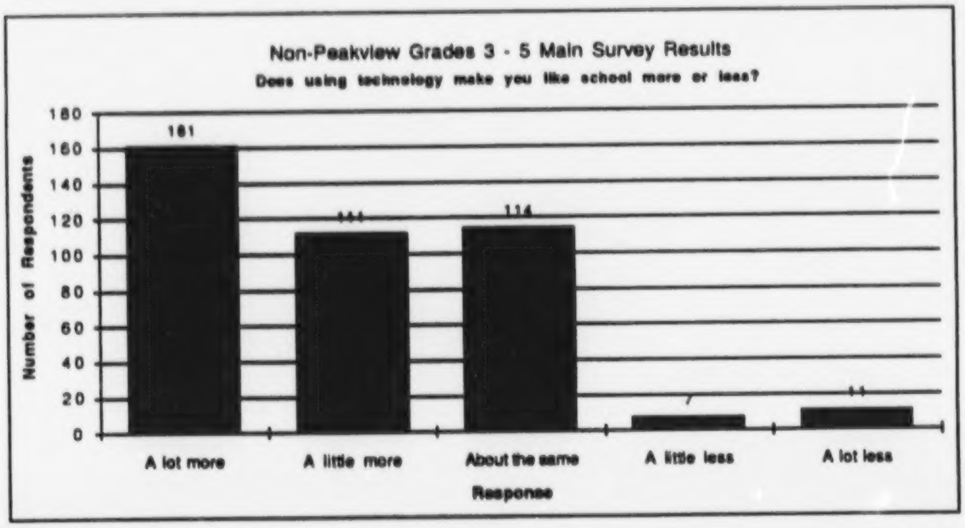
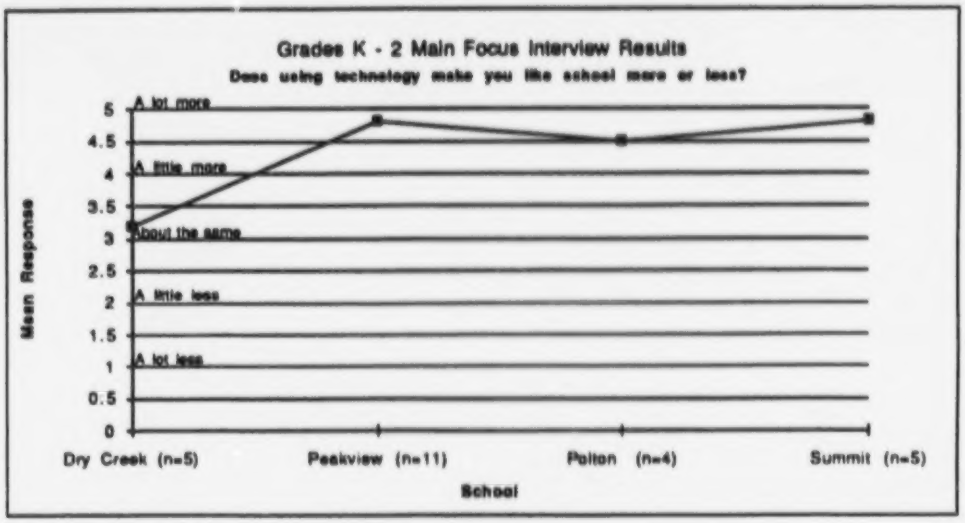
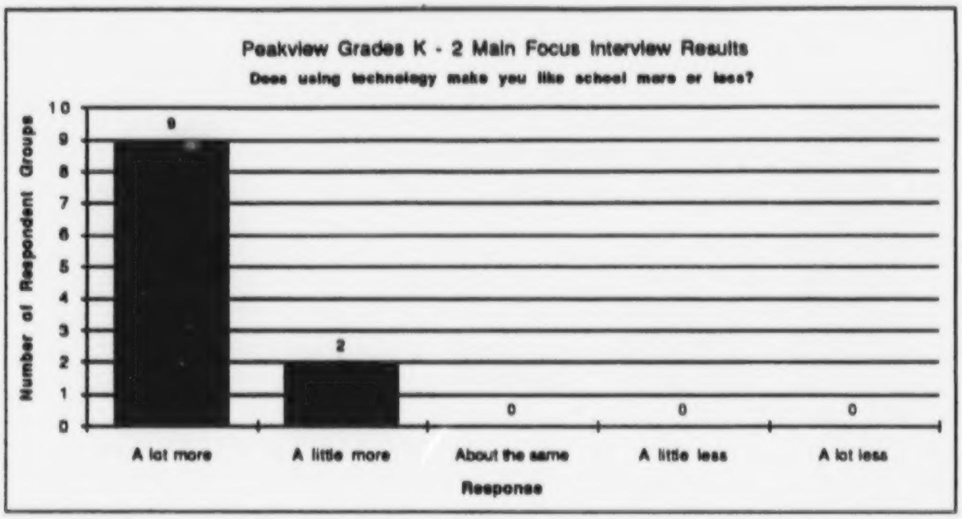

Non-Peakview Grades 3 - 5 Main Survey Results
Does using technology make you like school more or less?
Number of Respondents
180
160
140
120
100
80
60
40
20
0
161
111
114
7
11
A lot more
A little more
About the same
A little less
A lot less
Response

Figure 75.


Grades K - 2 Main Focus Interview Results
Does using technology make you like school more or less?
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
A lot more
A little more
About the same
A little less
A lot less
Dry Creek (n=5)
Peakview (n=11)
Palton (n=4)
Summit (n=5)
School


Peakview Grades K - 2 Main Focus Interview Results
Does using technology make you like school more or less?
Number of Respondent Groups
10
9
8
7
6
5
4
3
2
1
0
9
2
0
0
0
A lot more
A little more
About the same
A little less
A lot less
Response

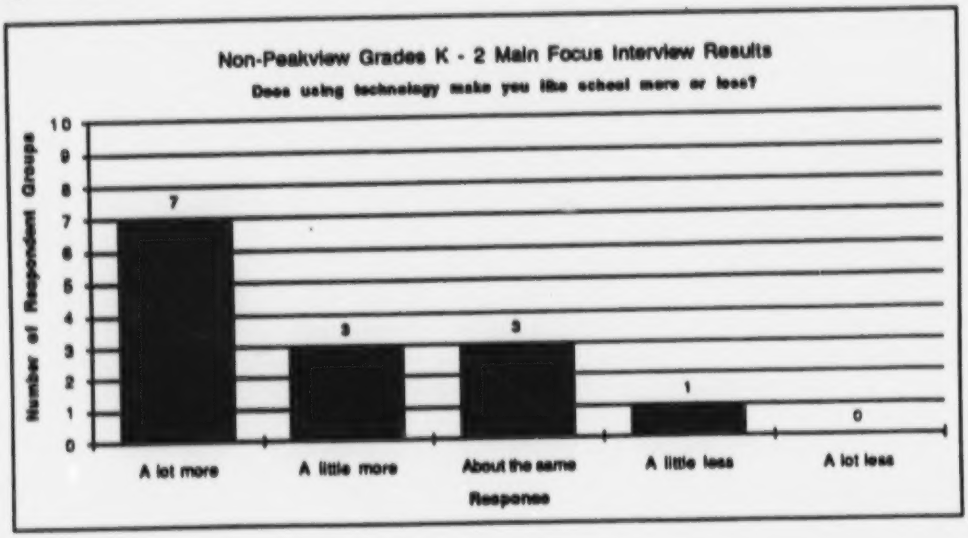


Figure 76.

Peakview teachers agreed that technology helped improve student attitudes toward school. In response to the statement, *Using technology is harmful to students' attitudes toward school* (Figure 77), Peakview teachers more emphatically disagreed with the statement than non-Peakview teachers ($\chi^2$=7.02, p<.01).

Peakview teacher comments corroborate their survey responses and suggest that technology often has a substantial impact on student attitudes toward school:

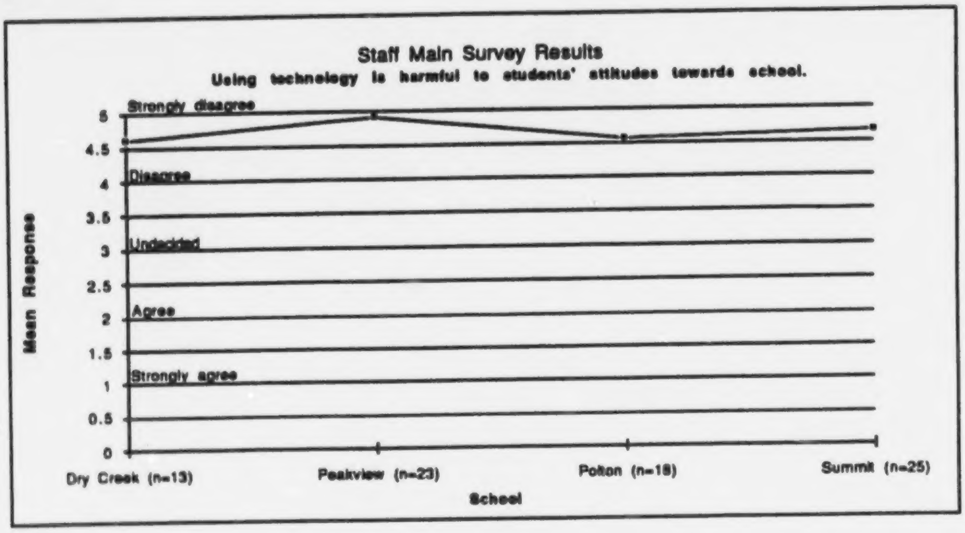
> *I look at it more attitudinally than anything. The kids are affected. 'Can I stay in at recess; can I stay late?' Some kids would choose to work with computers all the time. Some kids choose to work with the computer when it wouldn't always be the best choice.*
>
> *I believe there's a possibility it's having an effect on absenteeism.* Matt, intermediate teacher
>
> *I think they are excited about learning. It's a new avenue...they are doing writing, reading; things I didn't think first and second graders could do.*
>
> *I think mostly their self-confidence; maybe even some more independence...'I can do this on my own. This won't save, I can't get it to save. If this doesn't work, I try this or I try that.*
>
> *Motivation is high, and as a result, good things have happened. One of my students who wouldn't consider himself a good student, lot of labels [slow learner, etc.] has become a good writer and learner. [For example, a] video disc lesson on Big Cats that he created. Parent conferences are just around the corner. [A student will say,] "Be sure my mom sees this; she won't believe I have done it."*

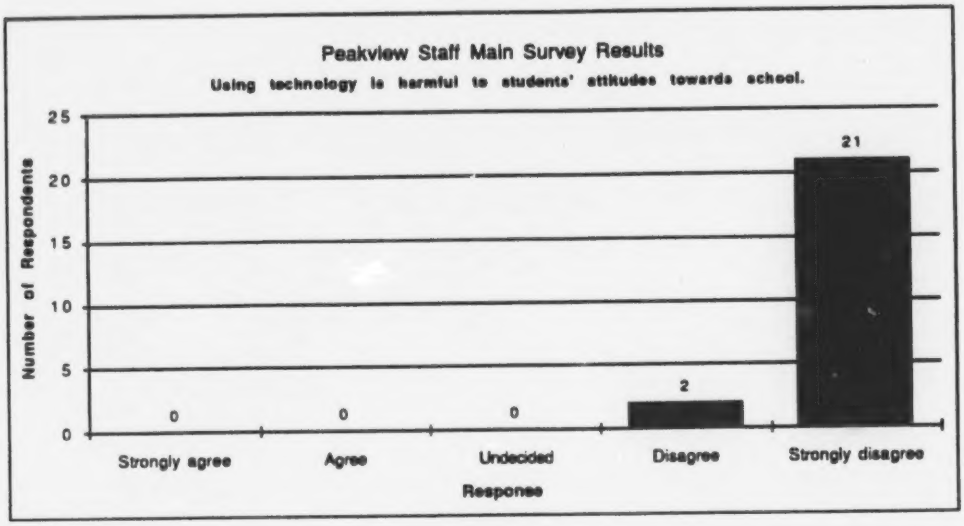
When questioned about the effects of technology on students' attitudes towards school one teacher responded:

> *It has improved it. We've got three days a week where there are kids coming to*

> *school at 7:30 AM to work on the computers. They are there voluntarily every day on time.*
>
> *At the beginning of the year I was shocked at how many computers there were. I was also scared because I had no experience but that changed really quickly.*

There seems to be fairly good evidence that technology plays a positive role in students' perceptions of school. Technology is one of the things that makes school "fun" according to many students. The perspectives of teachers concur with student reports on this issue.


Staff Main Survey Results
Using technology is harmful to students' attitudes towards school.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly disagree
Disagree
Undecided
Agree
Strongly agree
Dry Creek (n=13)
Peakview (n=23)
Polton (n=18)
Summit (n=25)
School


Peakview Staff Main Survey Results
Using technology is harmful to students' attitudes towards school.
Number of Respondents
25
20
15
10
5
0
0
0
0
2
21
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

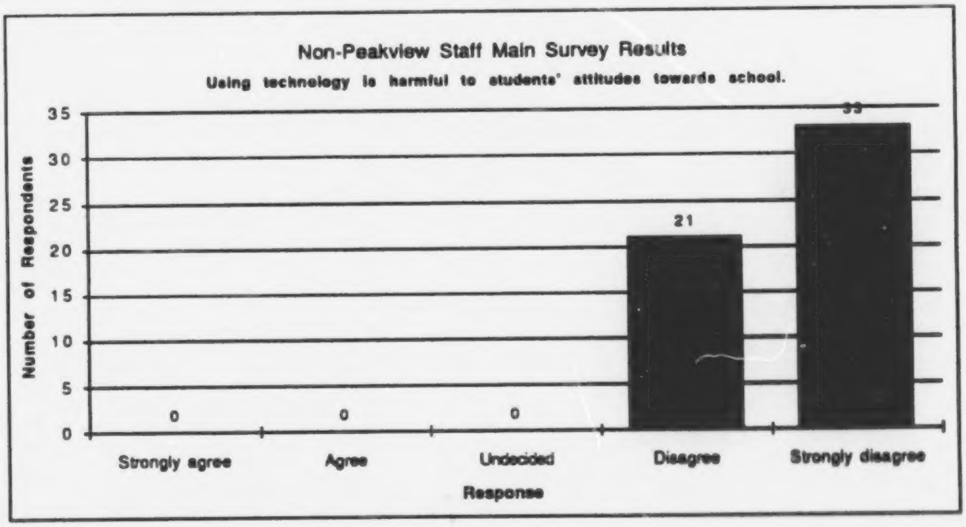
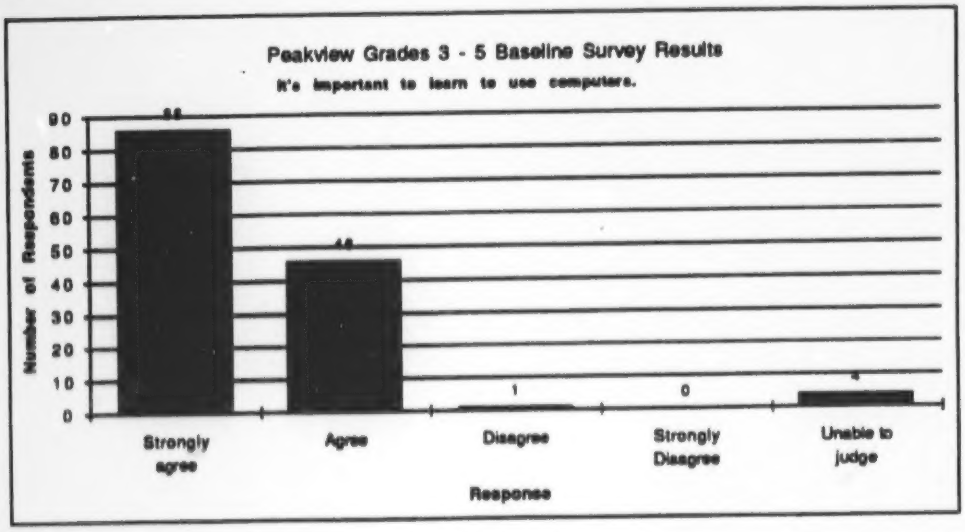
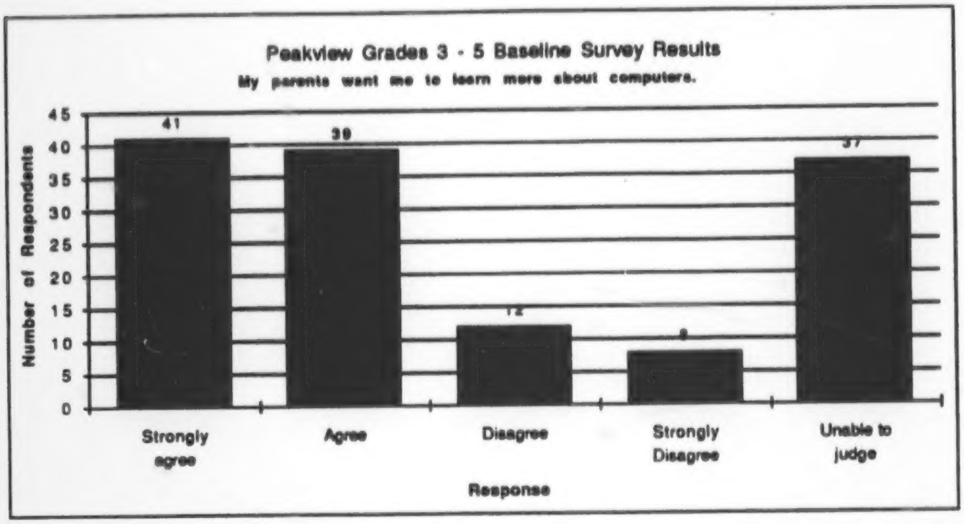

Non-Peakview Staff Main Survey Results
Using technology is harmful to students' attitudes towards school.
Number of Respondents
35
30
25
20
15
10
5
0
0
0
0
21
35
Strongly agree
Agree
Undecided
Disagree
Strongly disagree
Response

Figure 77.

## Attitudes Toward Technology

Peakview students were asked in the August Baseline Survey several questions aimed at gauging their feelings toward the technology available at the school. Intermediate students generally agreed about the importance of learning to use computer, about their parents' endorsing their learning, and that technology was a good way to learning something new (see Figure 78 below).


Peakview Grades 3 - 5 Baseline Survey Results
It's important to learn to use computers.
Number of Respondents
0
10
20
30
40
50
60
70
80
90
1
0
Strongly agree
Agree
Disagree
Strongly Disagree
Unable to judge
Response


Peakview Grades 3 - 5 Baseline Survey Results
My parents want me to learn more about computers.
Number of Respondents
0
5
10
15
20
25
30
35
40
45
41
39
12
8
37
Strongly agree
Agree
Disagree
Strongly Disagree
Unable to judge
Response

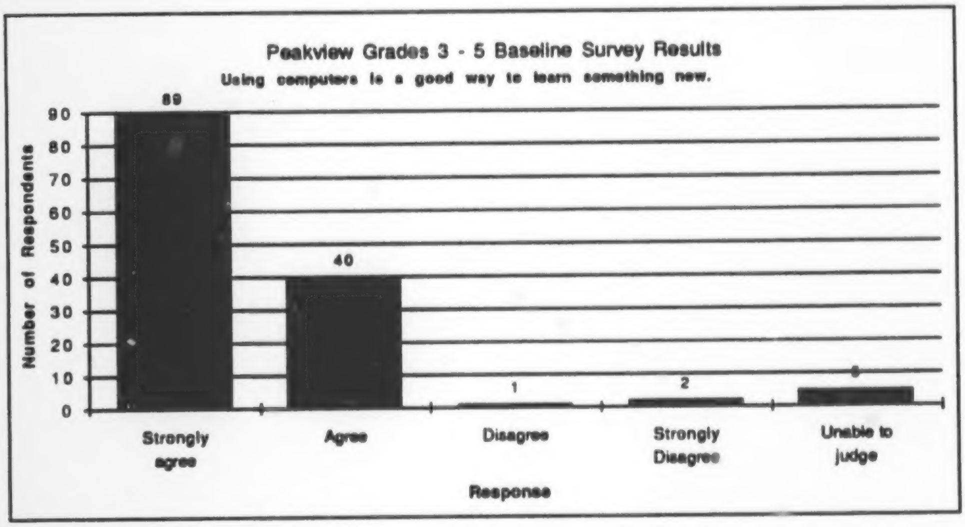

Peakview Grades 3 - 5 Baseline Survey Results
Using computers is a good way to learn something new.
Number of Respondents
0
10
20
30
40
50
60
70
80
90
89
40
1
2
Strongly agree
Agree
Disagree
Strongly Disagree
Unable to judge
Response

Figure 78.

Intermediate students at all four schools uniformly reported wanting to learn more about technology (Figure 79), with Peakview students showing markedly greater enthusiasm ($\chi^2=33.50$, $p<.001$). Primary students in focus interviews at all four schools unanimously agreed with the same statement. Students at the four schools also concurred that learning about technology was an important goal (Figures 83 and 84). Again, Peakview intermediate students showed a stronger conviction than non-Peakview students ($\chi^2=9.85$, $p<.05$).

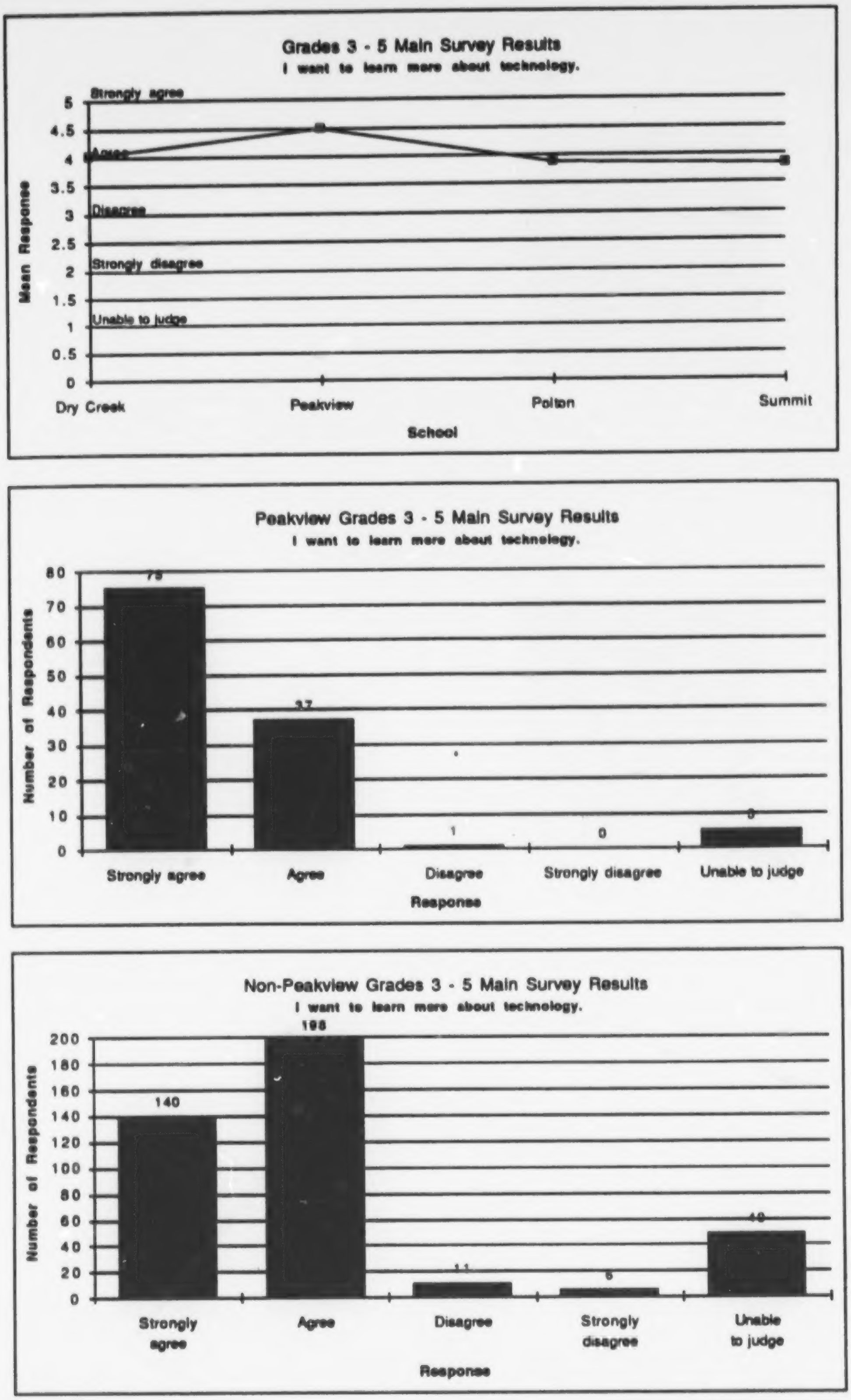
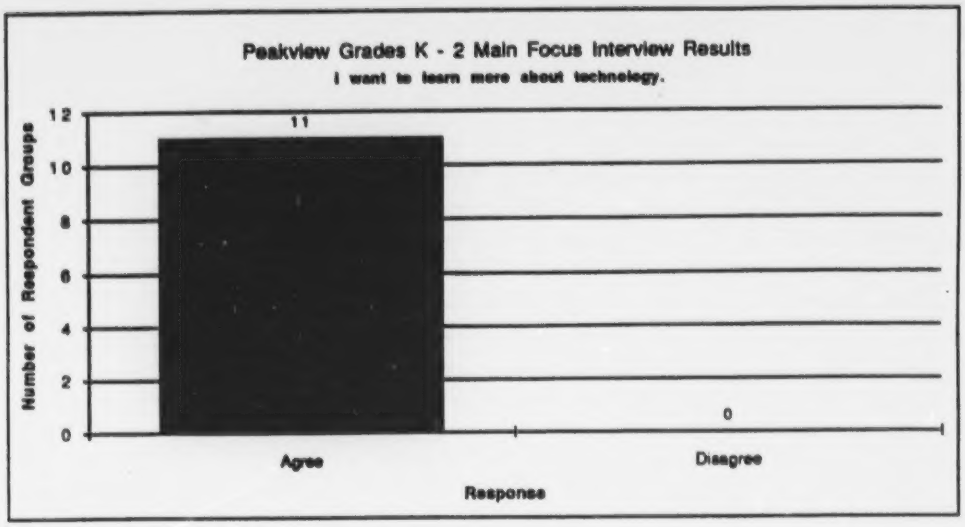

Grades 3 - 5 Main Survey Results
I want to learn more about technology.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Dry Creek
Peakview
Polton
Summit
School
Peakview Grades 3 - 5 Main Survey Results
I want to learn more about technology.
Number of Respondents
80
70
60
50
40
30
20
10
0
75
37
1
0
6
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response
Non-Peakview Grades 3 - 5 Main Survey Results
I want to learn more about technology.
Number of Respondents
200
180
160
140
120
100
80
60
40
20
0
140
198
11
6
49
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

Figure 79.


Peakview Grades K - 2 Main Focus Interview Results
I want to learn more about technology.
Number of Respondent Groups
0
2
4
6
8
10
12
11
0
Agree
Disagree
Response

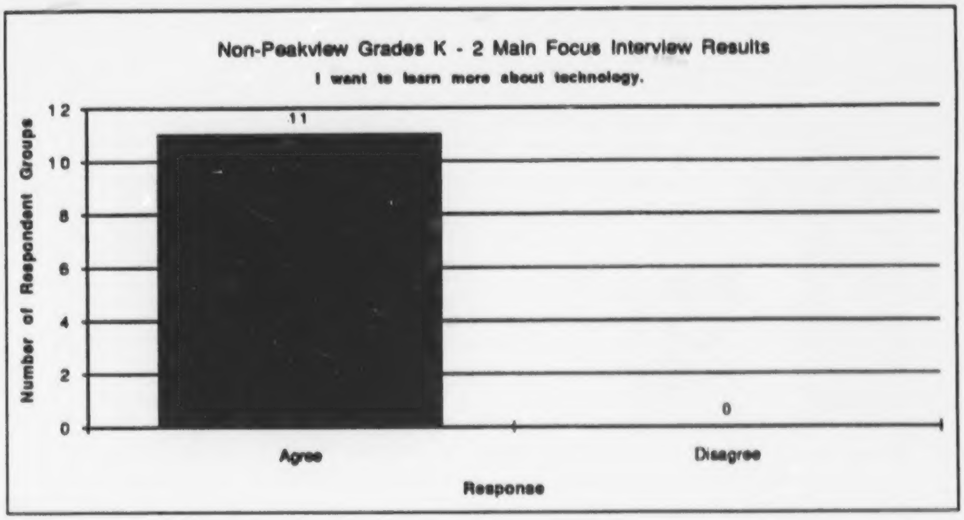
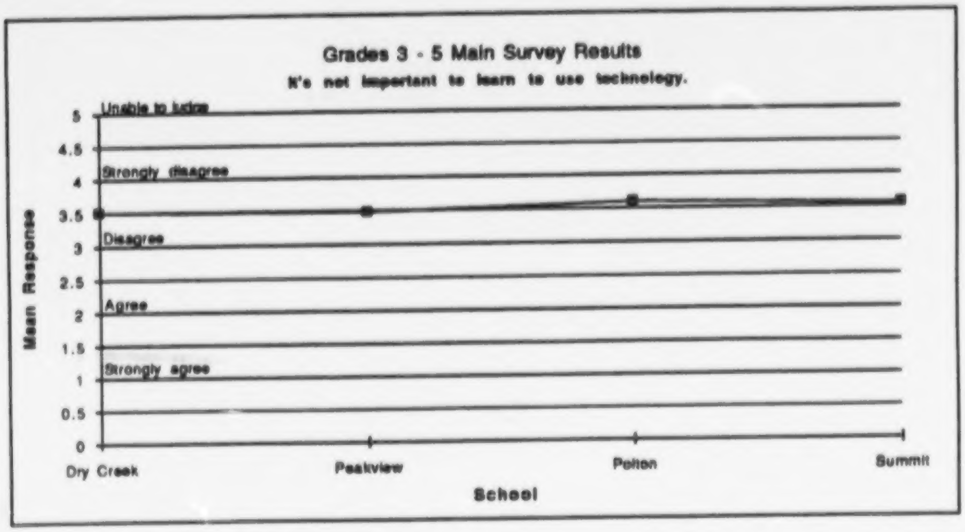
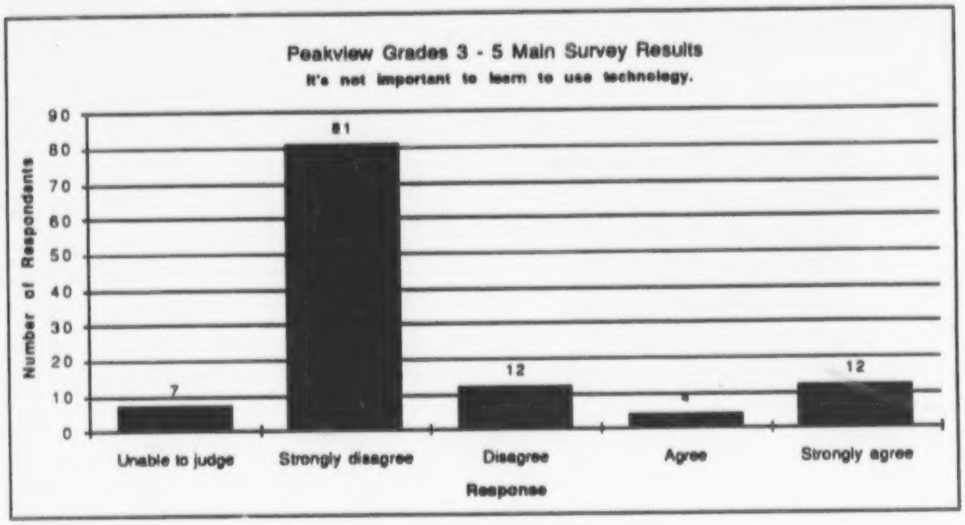

Non-Peakview Grades K - 2 Main Focus Interview Results
I want to learn more about technology.
Number of Respondent Groups
0
2
4
6
8
10
12
11
0
Agree
Disagree
Response

Figure 80.


Grades 3 - 5 Main Survey Results
It's not important to learn to use technology.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Unable to judge
Strongly disagree
Disagree
Agree
Strongly agree
Dry Creek
Peakview
Polton
Summit
School


Peakview Grades 3 - 5 Main Survey Results
It's not important to learn to use technology.
Number of Respondants
90
80
70
60
50
40
30
20
10
0
7
81
12
12
Unable to judge
Strongly disagree
Disagree
Agree
Strongly agree
Response

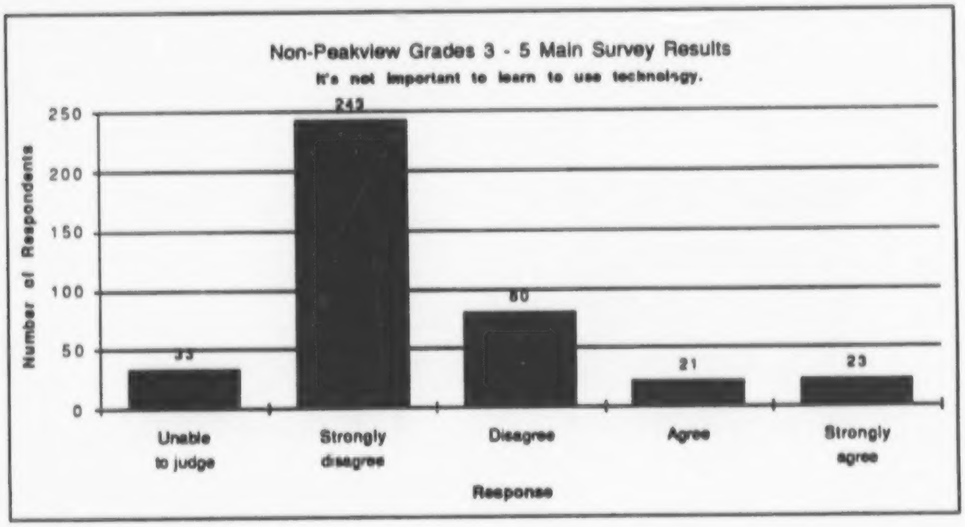
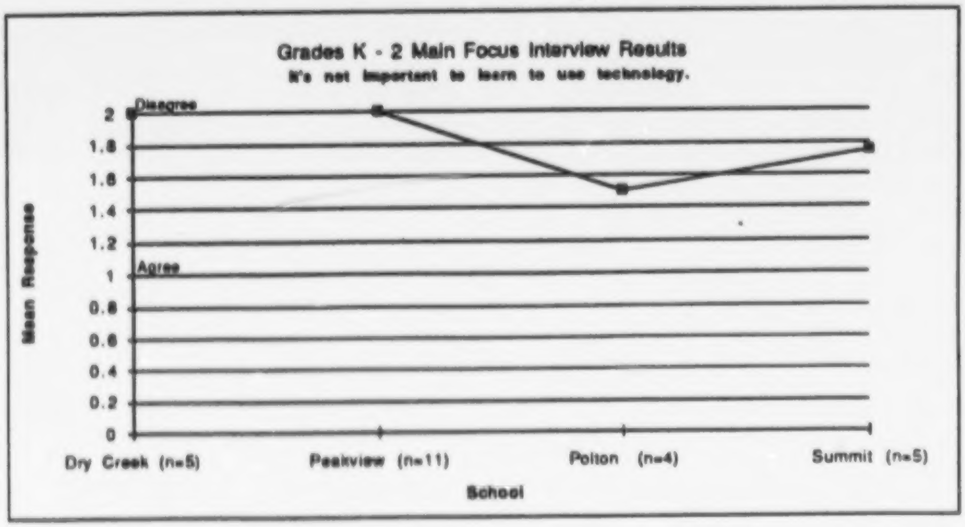
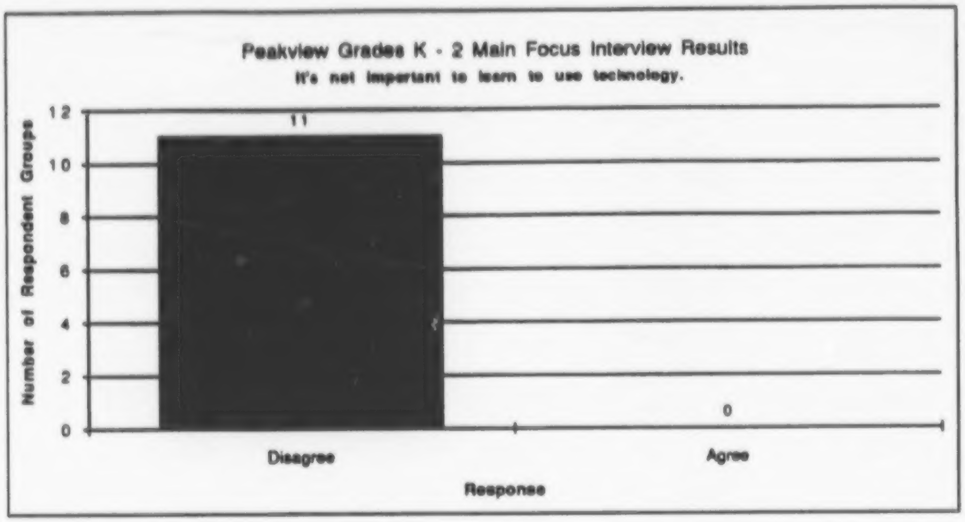

Non-Peakview Grades 3 - 5 Main Survey Results
It's not important to learn to use technology.
Number of Respondents
250
200
150
100
50
0
33
243
80
21
23
Unable to judge
Strongly disagree
Disagree
Agree
Strongly agree
Response

Figure 81.


Grades K - 2 Main Focus Interview Results
It's not important to learn to use technology.
Mean Response
Disagree
Agree
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dry Creek (n=5)
Peakview (n=11)
Pollon (n=4)
Summit (n=5)
School


Peakview Grades K - 2 Main Focus Interview Results
It's not important to learn to use technology.
Number of Respondent Groups
12
10
8
6
4
2
0
11
0
Disagree
Agree
Response

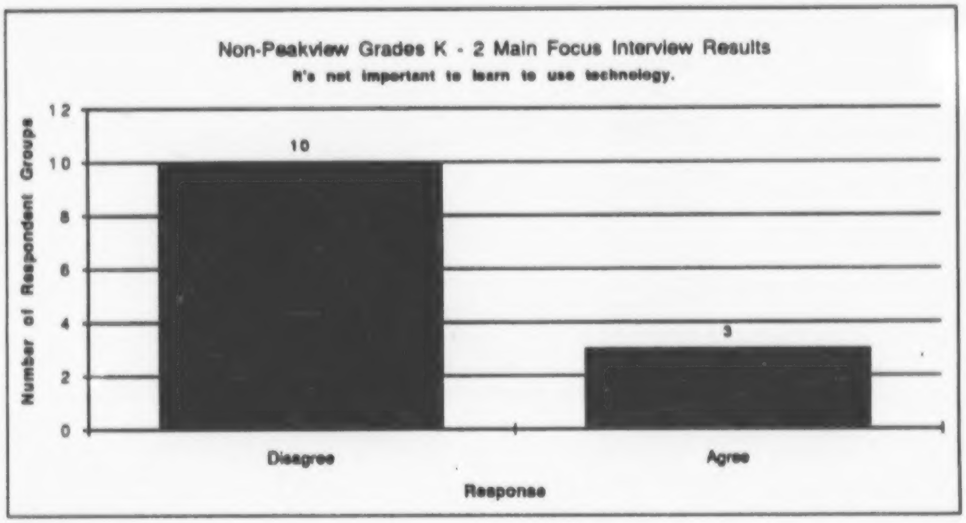

Non-Peakview Grades K - 2 Main Focus Interview Results
It's not important to learn to use technology.
Number of Respondent Groups
12
10
8
6
4
2
0
10
3
Disagree
Agree
Response

Figure 82.

Students across the four schools reported a preference for technology-based learning over textbook-based learning (Figures 86 and 87 on the following pages). Peakview intermediate students expressed stronger agreement than non-Peakview students ($\chi^2=10.98$, $p<.05$). This confirms an attitude expressed by Peakview intermediate students in the August Baseline Survey (Figure 83 below).

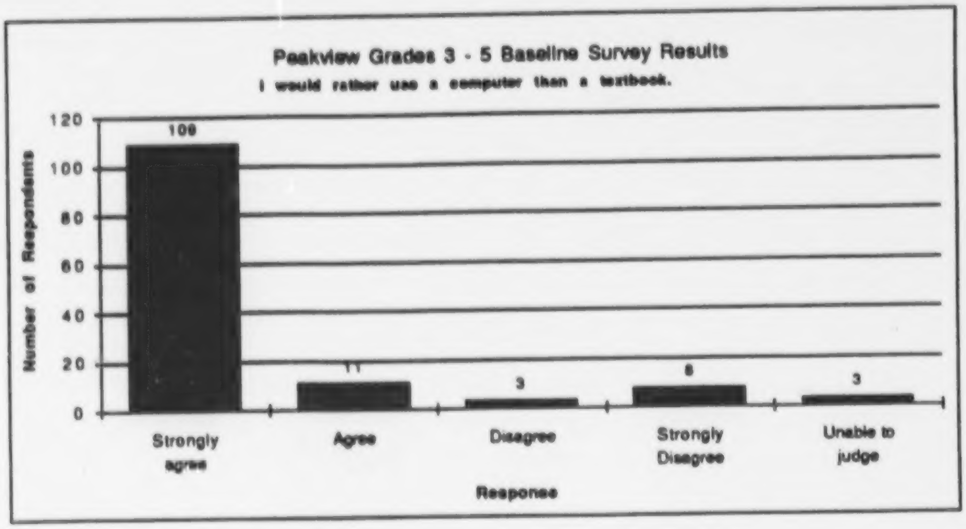
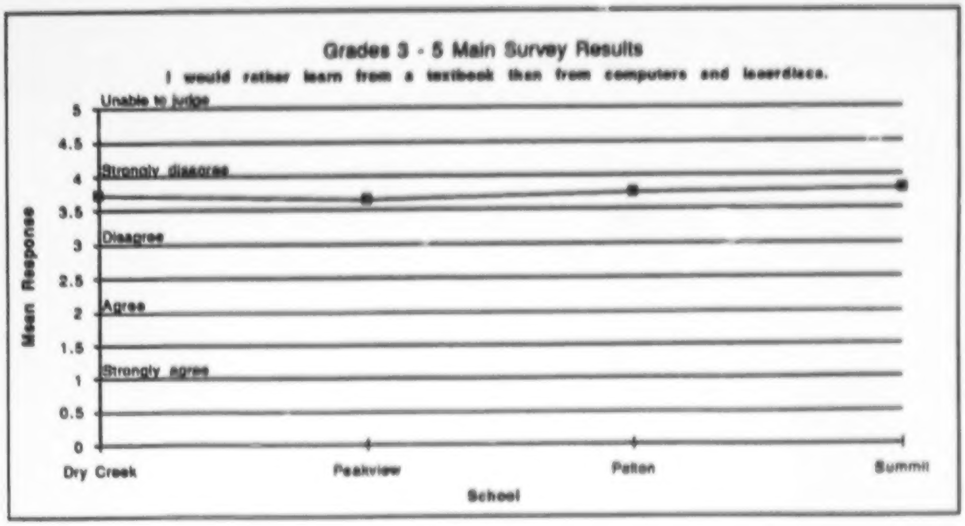
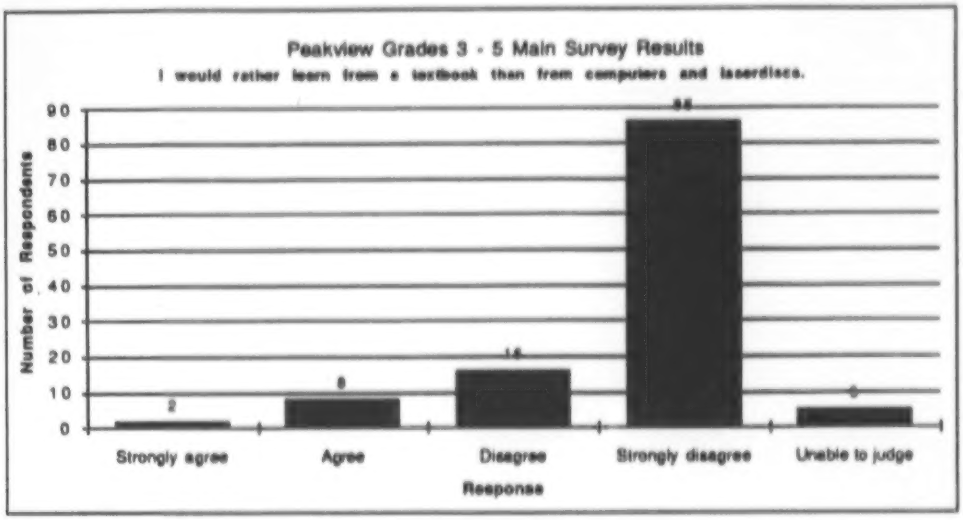


Figure 83.


Grades 3 - 5 Main Survey Results
I would rather learn from a textbook than from computers and laserdiscs.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Unable to judge
Strongly disagree
Disagree
Agree
Strongly agree
Dry Creek
Peakview
Paton
Summit
School


Peakview Grades 3 - 5 Main Survey Results
I would rather learn from a textbook than from computers and laserdiscs.
Number of Respondents
90
80
70
60
50
40
30
20
10
0
2
8
16
88
6
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

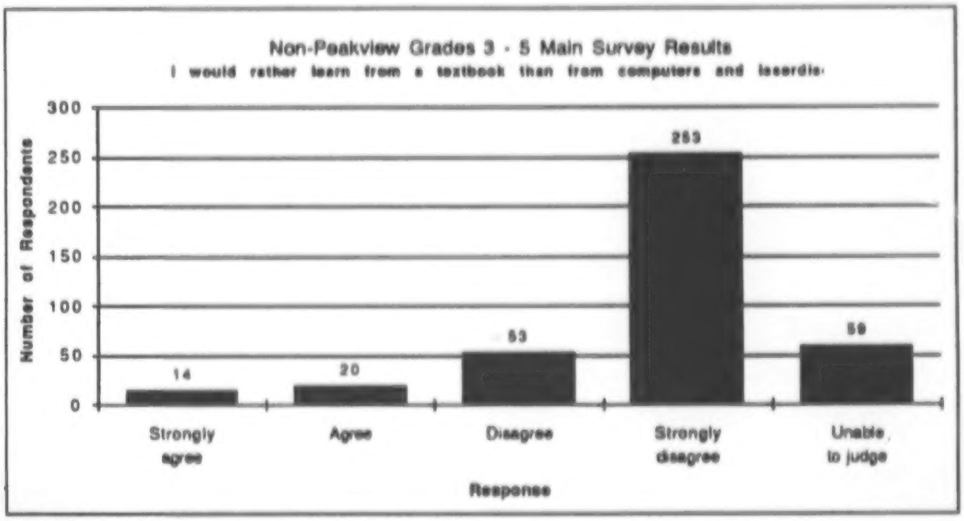
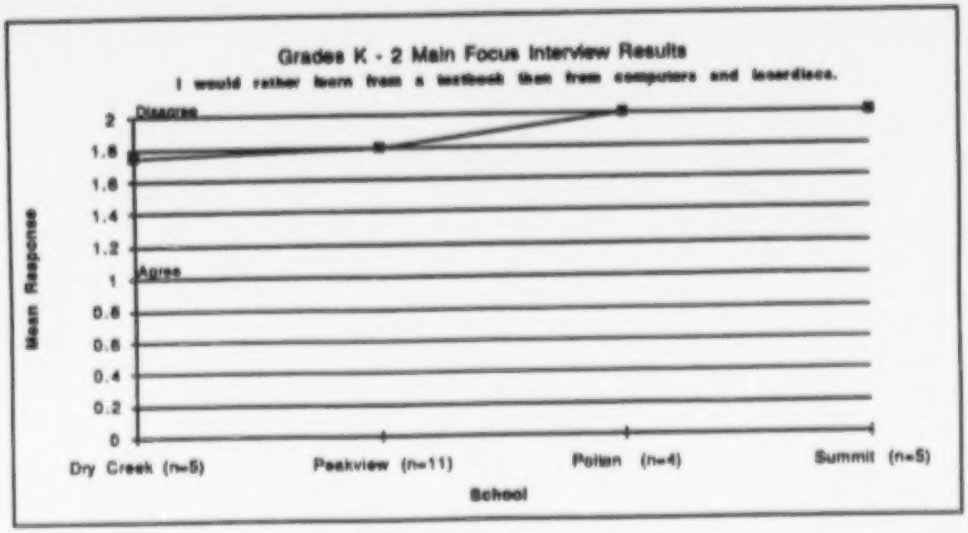
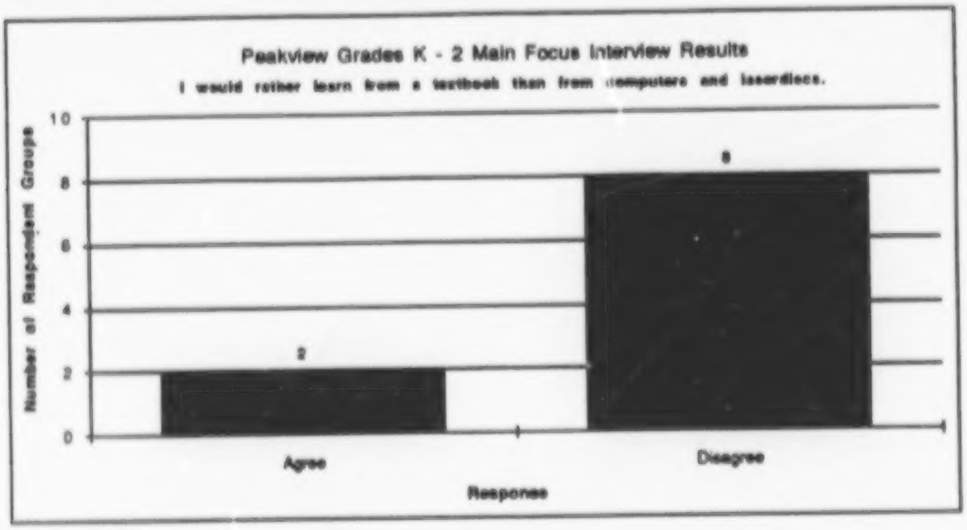

Non-Peakview Grades 3 - 5 Main Survey Results
I would rather learn from a textbook than from computers and laserdis-
Number of Respondents
300
250
200
150
100
50
0
14
20
53
253
59
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

Figure 84.


Grades K - 2 Main Focus Interview Results
I would rather learn from a textbook than from computers and laserdiscs.
Mean Response
Disagree
Agree
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dry Creek (n=5)
Peakview (n=11)
Polton (n=4)
Summit (n=5)
School


Peakview Grades K - 2 Main Focus Interview Results
I would rather learn from a textbook than from computers and laserdiscs.
Number of Respondent Groups
10
8
6
4
2
0
2
8
Agree
Disagree
Response

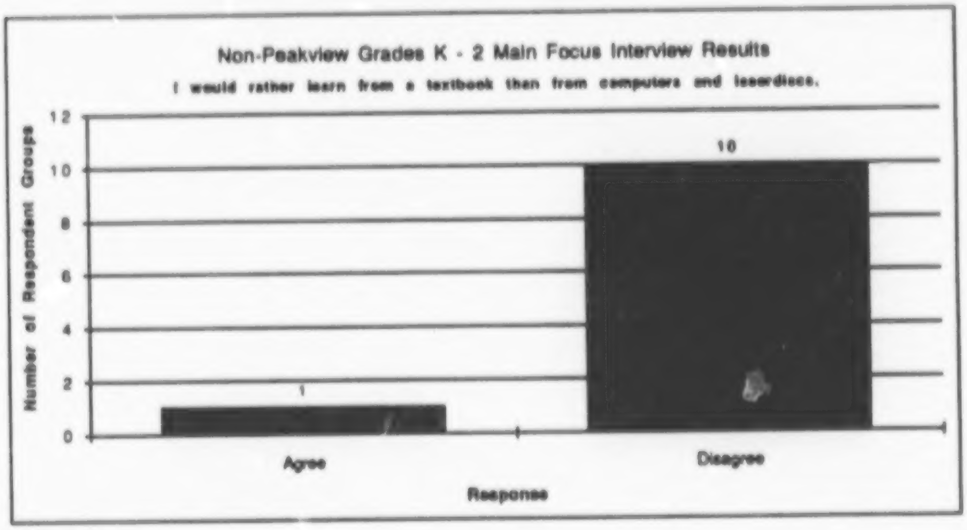

Non-Peakview Grades K - 2 Main Focus Interview Results
I would rather learn from a textbook than from computers and laserdiscs.
Number of Respondent Groups
12
10
8
6
4
2
0
1
10
Agree
Disagree
Response

Figure 85.

Teachers confirmed positive student attitudes regarding technology.

> *They love the computers! For Free Choice Center, I always have to say "Who wants to go to the computers first?" It's the most favored thing that they like to do.*
>
> *They love the technology. They have a kind of 'I can' attitude.*

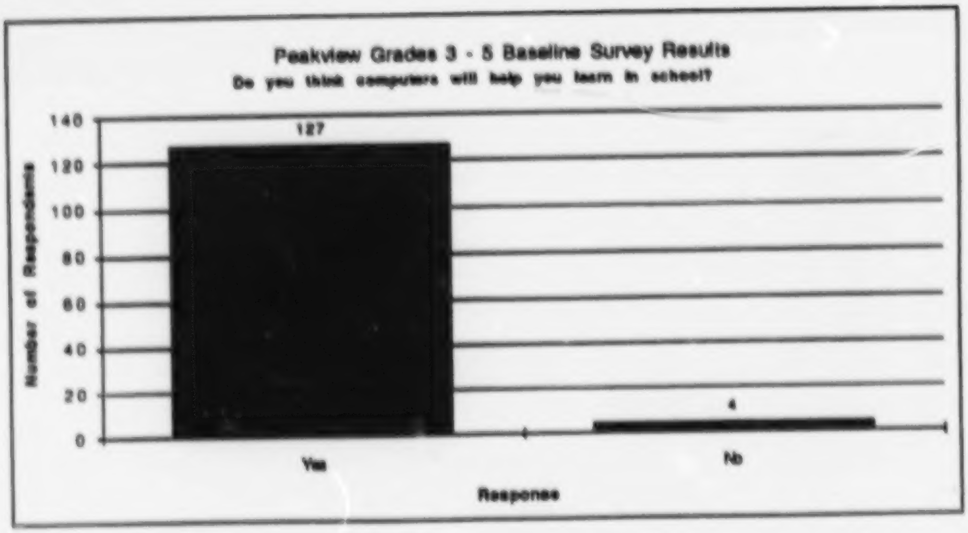
Students spoke for themselves about their attitudes toward the technology:

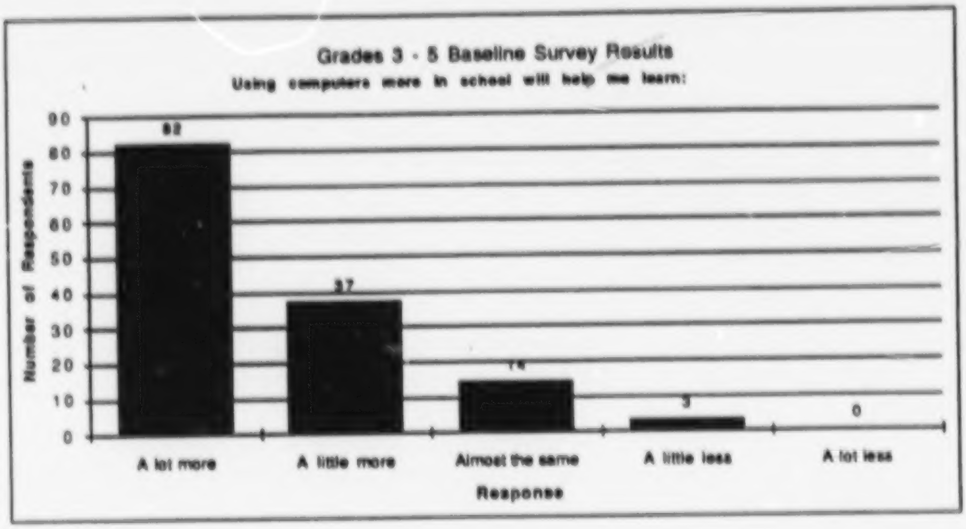
> *Technology is really a outstanding thing. I hope I am good in technology. We didn't use computers much in our old school. Some of the people in our class are really good typers on the computer. I really like my school. I'm glad we have a lot of computers.* Brittany
>
> *I used to write and write. But I never had any pleasure with it. I would cherish the times I got to go to the computer lab. I never dreamed of using as cool technology as I do now.* Anne
>
> *I love technology and praise this school for preparing me for tomorrow's society. I am very scared about tomorrow, but I am prepared and confident in my peers. I wish to have a future part in the technology market. I also think that future school should have this privilege.* Kevin

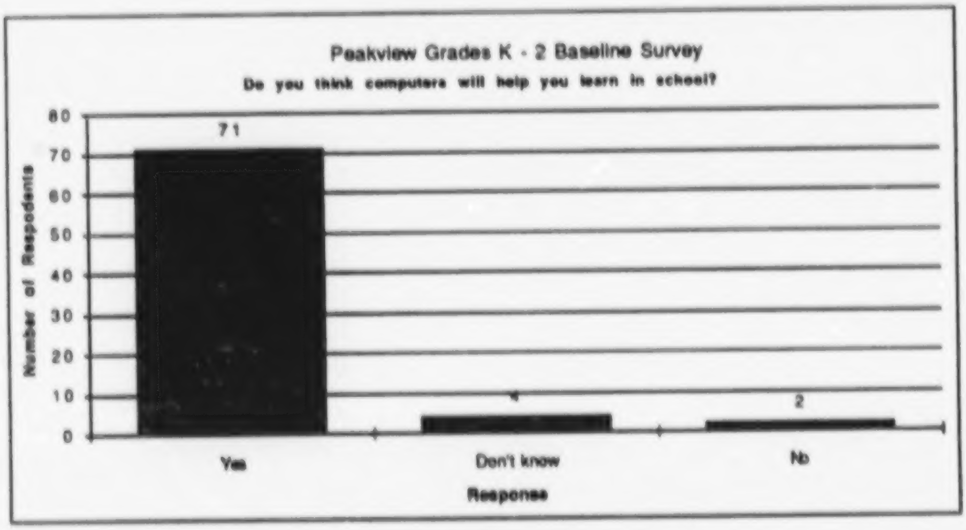
Viewing the data in aggregate, it is clear that students at all four schools respond favorably to technology. Moreover, Peakview intermediate students consistently agreed more emphatically to statements regarding technology. This stronger attitude may be attributable to any of several factors, including kind of computer (color Macintosh), classroom access, software and availability, or other implementation and teaching factors.

## Attitude Toward Learning

Peakview students were asked in the August Baseline Survey questions related to technology and learning, shown in Figure 86 below. Students at all grade levels report agreement that technology will help them learn.


Peakview Grades 3 - 5 Baseline Survey Results
Do you think computers will help you learn in school?
140
120
100
80
60
40
20
0
Number of Respondents
127
4
Yes
No
Response


Grades 3 - 5 Baseline Survey Results
Using computers more in school will help me learn:
90
80
70
60
50
40
30
20
10
0
Number of Respondents
82
37
14
3
0
A lot more
A little more
Almost the same
A little less
A lot less
Response


Peakview Grades K - 2 Baseline Survey
Do you think computers will help you learn in school?
80
70
60
50
40
30
20
10
0
Number of Respodents
71
4
2
Yes
Don't know
No
Response

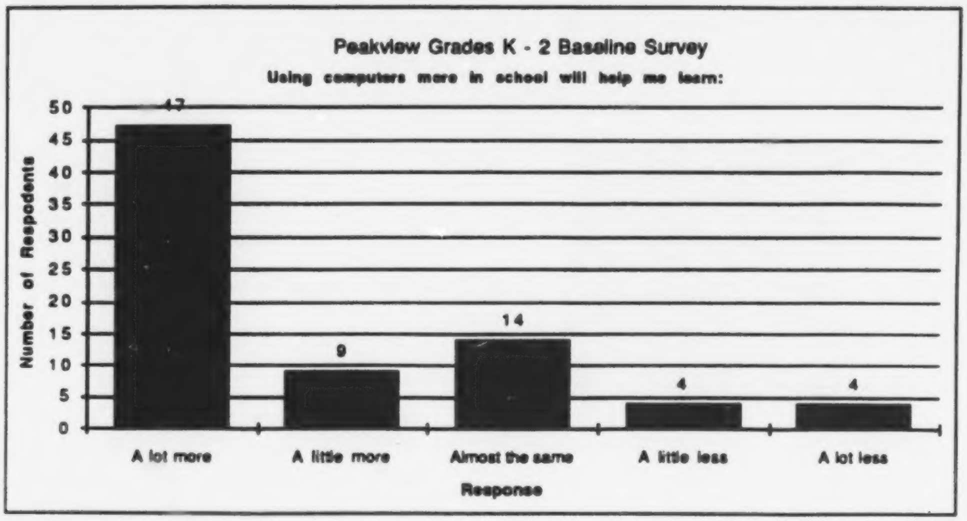


Figure 86.

Here is a typical Peakview student interview response to the question, *Does the technology help you learn? How?*

> *Yeah. It shows me new stuff, and it shows what we don't know, and it tells about what we don't know. It just shows it and we read it and we find out.* Jeff

Peakview teachers observed that students are highly motivated to stay on task and learn with technology:

> *The kids are affected. Can I stay in recess, can I stay late? We have such a short recess period, I wish we had more opportunities to do more.* Michael, intermediate teacher

> *98% of the kids will choose to stay in and work with computers rather than go outside for recess .* Nora, Kindergarten teacher

> *Kids come early, stay late, stay in at recess.* Brad, Kindergarten teacher

Students commented:

> *I like computers a lot and I do as much as I can on computers. We've got a computer at home. It's a quicker way to do things. It's fun and it's good to learn with.* Charles Johnson

> *If we didn't have technology everyone would be bored...there'd be nothing to do.* Matthew

On the negative side, however, another student complained:

> *It doesn't give you the complete answer to things. When you need to find things, sometimes you can't find it on the computer... and it doesn't give you enough detail on things. It doesn't, like, tell you if you got the right answer...it just goes on...I'm used [to] hearing if I'm right.* Matthew

Open-ended responses in the Intermediate Survey suggest that students link technology use with learning. When asked, *How much can technology help you in school? Why?*, intermediate students made references to learning first, followed by a number of other types of responses (see Table 17 below).

**How much can technology help you in school? Why?**

| | |
|---|---|
| 28 | Better learning |
| 26 | Provides help |
| 13 | It's fun! |
| 11 | Provides information |
| 7 | More efficient, productive |
| 7 | Has limits |
| 3 | It teaches you |
| 2 | Don't use technology |
| 8 | Miscellaneous other responses |

Table 17. *Open-ended responses to Intermediate Survey.*

Again, when asked in open-ended fashion what they liked most about technology, intermediate students again mentioned learning gains, followed by fun and games (see Table 18 below).

**What do you like most about technology?**

| | |
|---|---|
| 25 | Help provided in learning |
| 24 | It's fun! |
| 20 | Games |
| 10 | Don't know |
| 9 | Efficiency, productivity |
| 8 | Hardware |
| 8 | Program(s) |
| 7 | Particular activity |
| 5 | It's easy |
| 4 | Art/graphics |
| 1 | Independent/individual aspects |

Table 18. *Open-ended responses to Intermediate Survey.*

Provided below is a sampling of Peakview intermediate students related to technology and the learning process. (Note: Original spelling is retained.)

> *I used to have to just use books for information; now I could use a laserdisc instead. Also we had computers at my old school but not in the classroom. We had to go to a computer lab every two weeks and mainly all we did on them were games.*

> *But now I get to work and play on the computers. And it made me learn that you don't need to use paper and pencil to get a report written. My favorite is My Personal Profile because you can paste pictures in your stack.*
>
> *...I learned how to start the computer. I learnd how to use HyperCard, Wrighting Center, Munchers, Kid Pix's. Every thing exsept Carmen USA. I am very proud of my play called "Peter Pan" and my play "Cinderella". In fact I am going to put on the play Peter Pan for my class. I hope you can get achnes and read them. In the coming years I think there will be a computer for every one in the class. Technology has changed my life as we speak. Thanks so much for the experenss.*
>
> *Wow! This is Fantastick! I am having so much fun doing this! I've wrote about 5 story's on theese awsome computers! They also help me so much on my research!*

Peakview teachers agree that students are more motivated to learn with technology:

> *I have marveled at the cooperative learning and self-motivated learning that has taken place because of having the computers in the classroom. I cannot believe how far these kids have come with their own expertise in using them.*
>
> *Technology has taught me and the children in my class to take a risk, learn and at the same time feel frustrated and success. We are learning together and I can't think of anything much better—children learning with adults and adults learning with children.*

One teacher suggests that technology can help students overcome attitudinal barriers to learning:

> *Technology has allowed my students to constantly access information from video discs, as well as traditional print material. This has been especially beneficial for those students who have a "book phobia"... who are afraid of reading. After listening to and viewing these multimedia resources, many students have gone on to read, read and read some more.* Adam, intermediate teacher

Most elementary students are oriented toward learning. They enjoy learning. It seems justifiable to generalize that most students associate technology with learning. They typically view technology as an aid to learning. For this reason, and for a variety of other reasons, the students have a positive attitude toward the technology itself.

## Attitude Toward Teachers

The effect on student-teacher relations seems to be sometimes affected by the technology. Peakview teachers were asked in interviews how they felt when their students knew more than they did about the technology. Without exception, teachers reported being willing to model being a learner to their students. As one teacher put it: "The modeling that adults do for children, and that children do for adults, are examples of the best of our beliefs about how all of us learn."

Several teacher reported occasions when students helped them solve computer-related problems. One teacher reported:

> *It has been a good experience for the kids to see me as a learner with them serving as the experts. I often find that they know more about using programs than I do. It has been great to have them be peer coaches.*

Most Peakview students feel that their teachers encourage them to use technology.

An intermediate interview question was: *Have you ever helped your teacher? Tell me about it.* Responses include:

> *Yeah. Mrs. Peterson, she put in a new disk, called Cosmic Osmo, and [my teacher] didn't know how to do it. When we switched, the teachers switched for two hours or something. She put in a new disk and didn't know how to do it. Actually a couple of kids showed her, a couple of kids and me. It's fun showing the teacher.* Jeff

> *This year at school they have inceraged [encouraged] me to right. Lost year my old teacher wanted me to right but I didn't. This school has helped me learn moore technology. This school helped the schools kids learn in a jenuis way.* Kris

In summary, there is some evidence to suggest that technology helps loosen up the teacher-student relationship, allowing occasions when teacher can model learning behaviors and other occasions when students have opportunities to be teachers. All the Peakview teachers reported feeling comfortable with these more flexible roles.

## Attitude Toward Self

When asked if technology makes them feel good about themselves, Peakview intermediate students agreed more strongly than non-Peakview students (Figure 87; $\chi^2=28.63$, $p<.001$). Primary students at all four schools also reported that using technology makes them feel good about themselves (Figure 88).

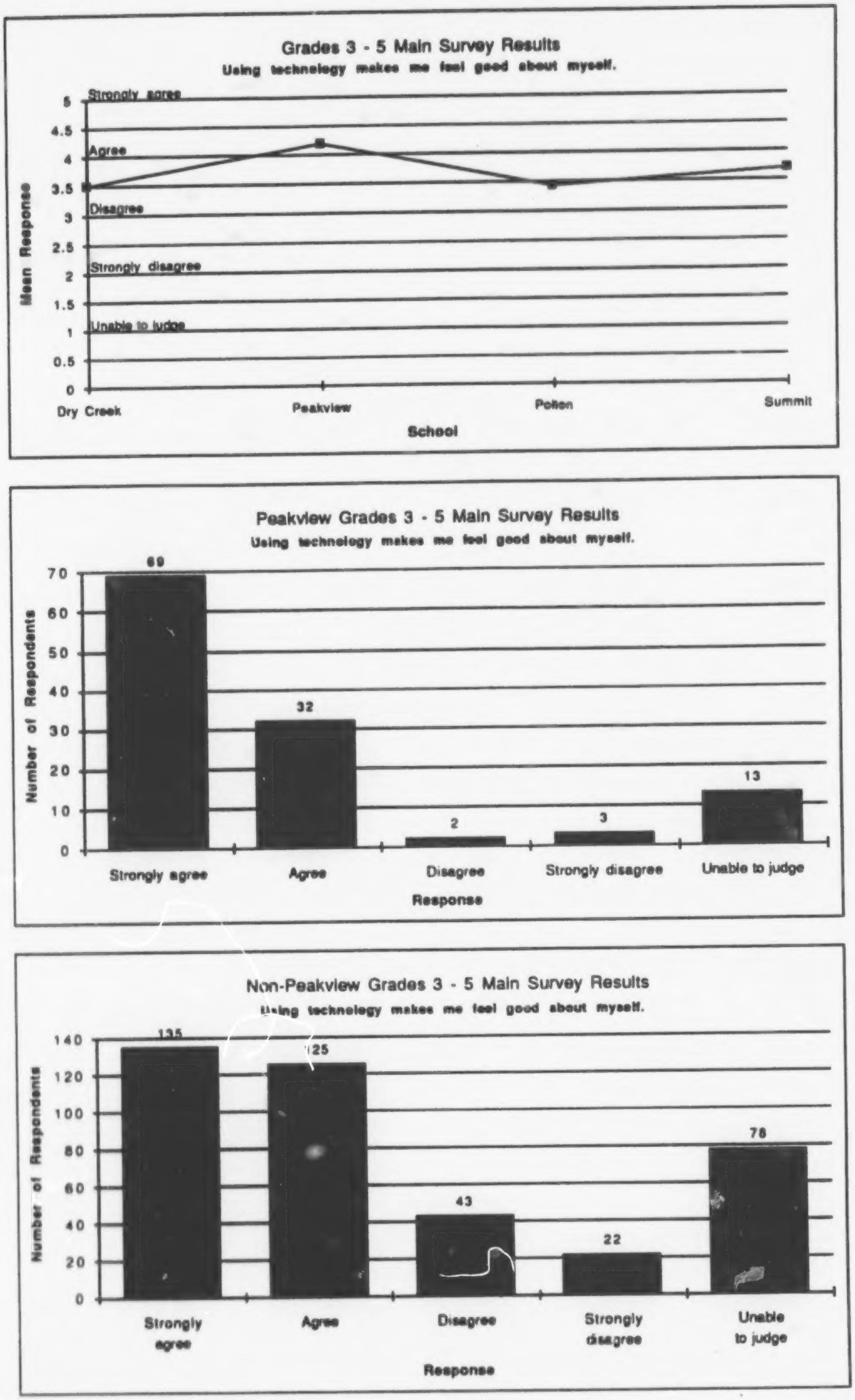
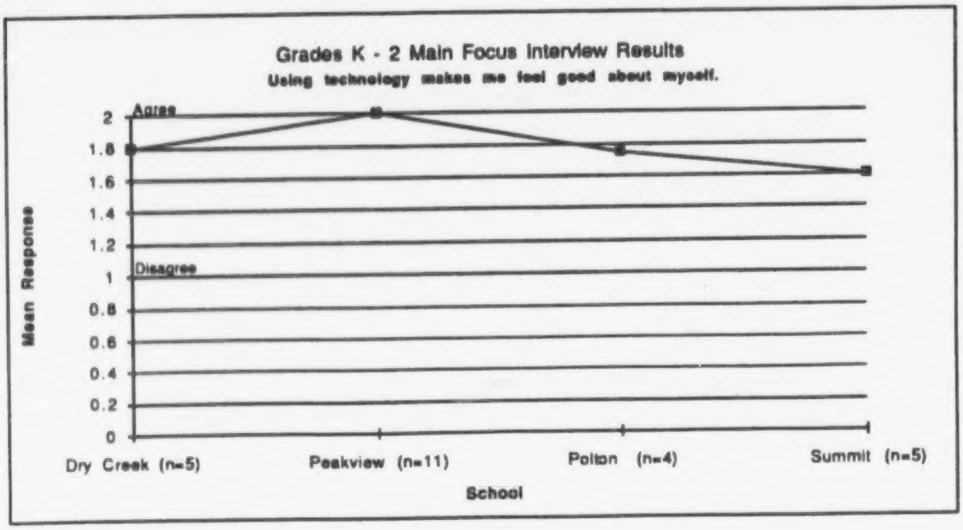
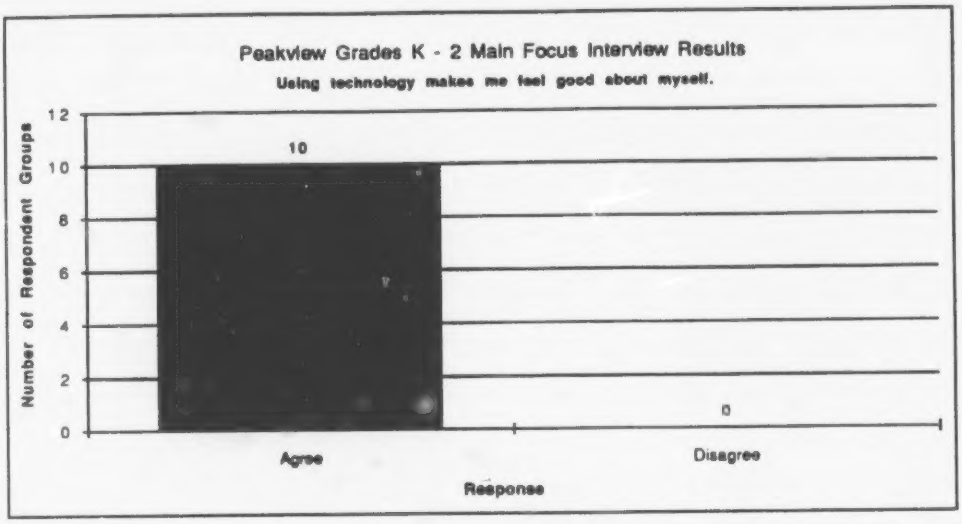

Grades 3 - 5 Main Survey Results
Using technology makes me feel good about myself.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Dry Creek
Peakview
Polton
Summit
School
Peakview Grades 3 - 5 Main Survey Results
Using technology makes me feel good about myself.
Number of Respondents
70
60
50
40
30
20
10
0
69
32
2
3
13
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response
Non-Peakview Grades 3 - 5 Main Survey Results
Using technology makes me feel good about myself.
Number of Respondents
140
120
100
80
60
40
20
0
135
125
43
22
78
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

Figure 87.


Grades K - 2 Main Focus Interview Results
Using technology makes me feel good about myself.
Agree
Disagree
Mean Response
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dry Creek (n=5)
Peakview (n=11)
Polton (n=4)
Summit (n=5)
School


Peakview Grades K - 2 Main Focus Interview Results
Using technology makes me feel good about myself.
Number of Respondent Groups
12
10
8
6
4
2
0
10
0
Agree
Disagree
Response

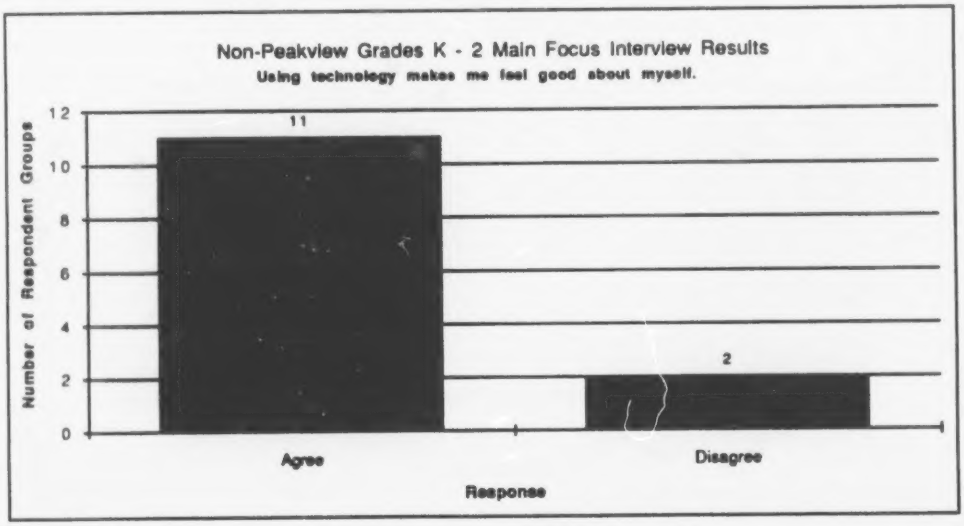

Non-Peakview Grades K - 2 Main Focus Interview Results
Using technology makes me feel good about myself.
Number of Respondent Groups
12
10
8
6
4
2
0
11
2
Agree
Disagree
Response

Figure 88.

Students' attitudes toward themselves also can be affected by their confidence in using technology. It is possible that students who try to use technology and fail could develop negative feelings toward themselves. To determine the extent of this problem, students were asked whether they viewed using technology as being hard or easy. In the August Baseline Survey, 83% of the Peakview intermediate students and 83% of the primary students responded that computers were "easy" (see Figure 89 below).

Again in May, the consensus response across schools was that technology is "easy" (Figure 90 on the following page). Still, 13% of intermediate Peakview intermediate students and 15% of non-Peakview students agreed that "technology is hard for me" (see Figure 91). Peakview students responded significantly more positive than non-Peakview students ($\chi^2$=15.14, p<.01). Primary students also reported positive responses (Figure 92).

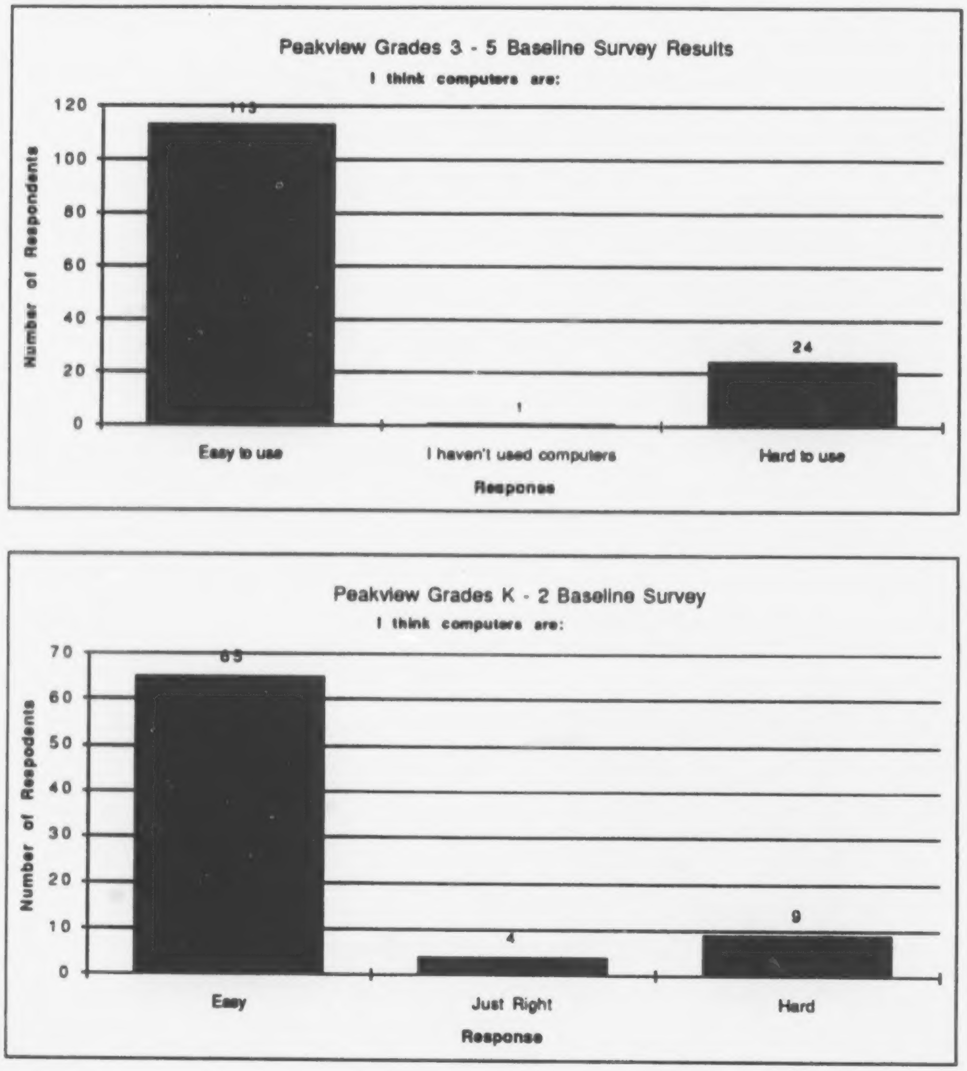


Figure 89.

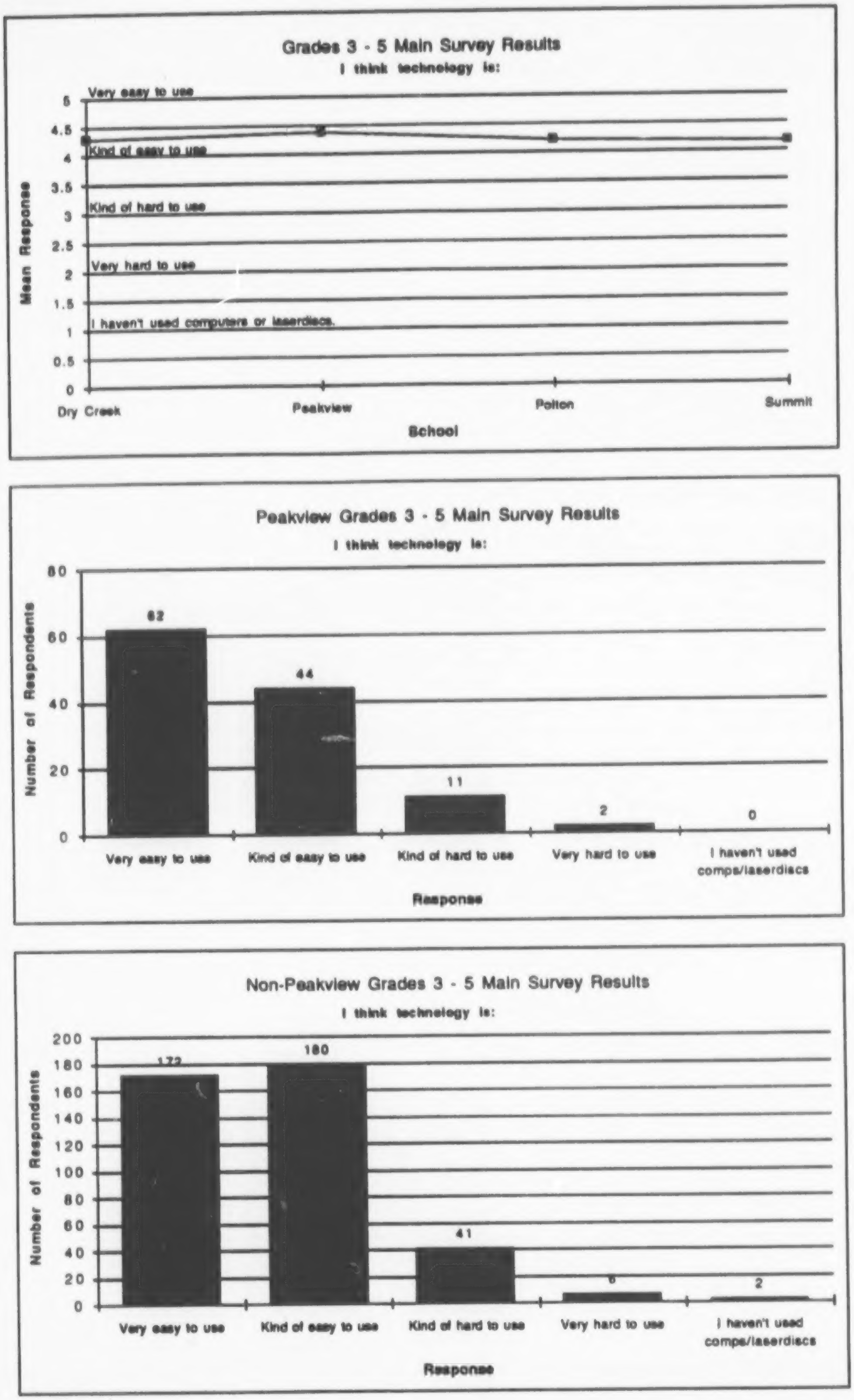
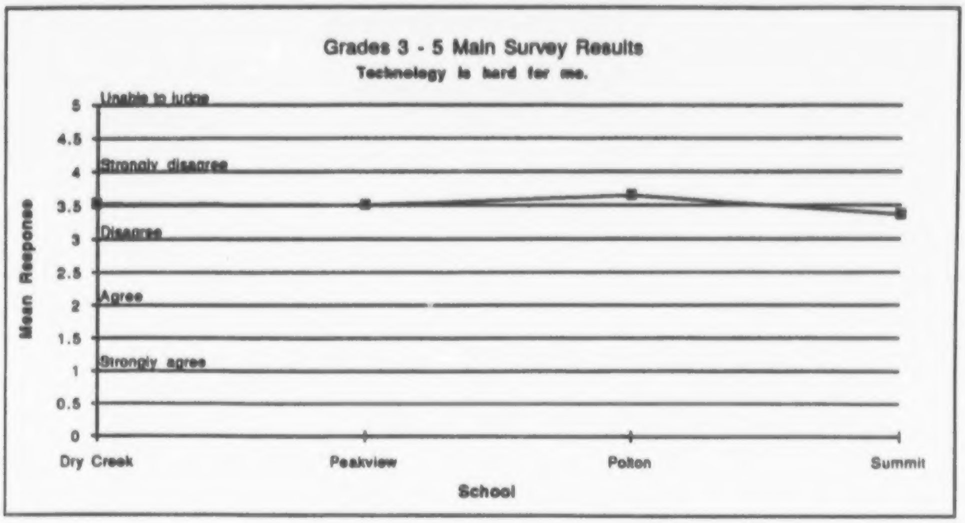
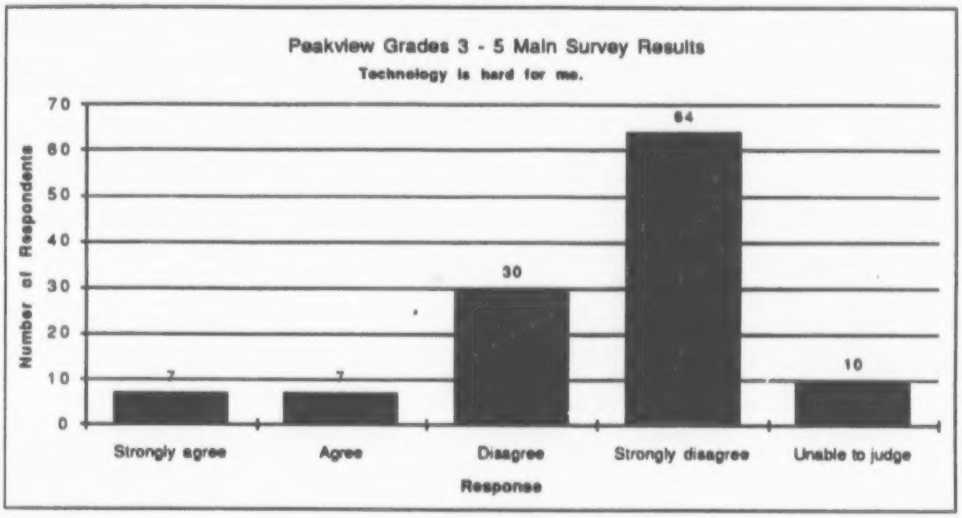

Grades 3 - 5 Main Survey Results
I think technology is:
Mean Response
Very easy to use
Kind of easy to use
Kind of hard to use
Very hard to use
I haven't used computers or laserdiscs.
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek
Peakview
Polton
Summit
School
Peakview Grades 3 - 5 Main Survey Results
I think technology is:
Number of Respondents
80
60
40
20
0
62
44
11
2
0
Very easy to use
Kind of easy to use
Kind of hard to use
Very hard to use
I haven't used comps/laserdiscs
Response
Non-Peakview Grades 3 - 5 Main Survey Results
I think technology is:
Number of Respondents
200
180
160
140
120
100
80
60
40
20
0
172
180
41
6
2
Very easy to use
Kind of easy to use
Kind of hard to use
Very hard to use
I haven't used comps/laserdiscs
Response

Figure 90.


Grades 3 - 5 Main Survey Results
Technology is hard for me.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Unable to judge
Strongly disagree
Disagree
Agree
Strongly agree
Dry Creek
Peakview
Polton
Summit
School


Peakview Grades 3 - 5 Main Survey Results
Technology is hard for me.
Number of Respondents
70
60
50
40
30
20
10
0
7
7
30
64
10
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

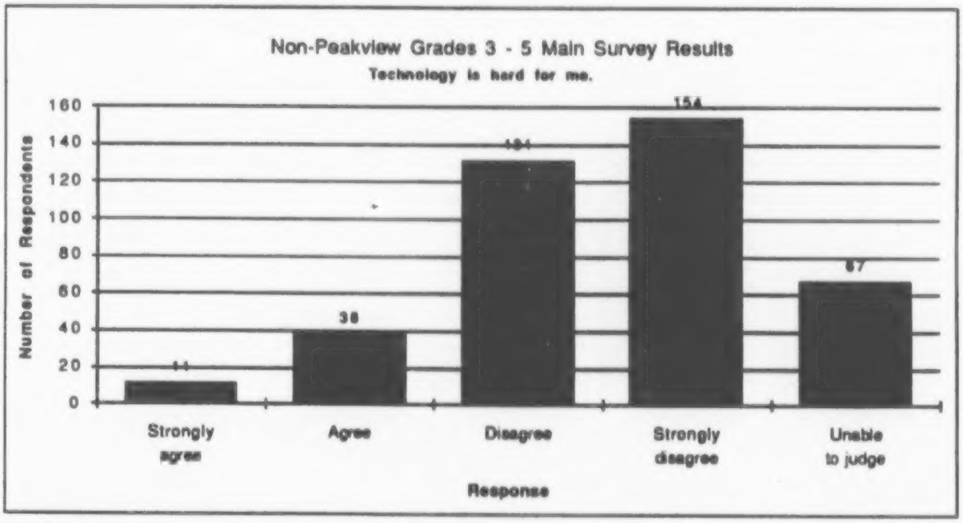
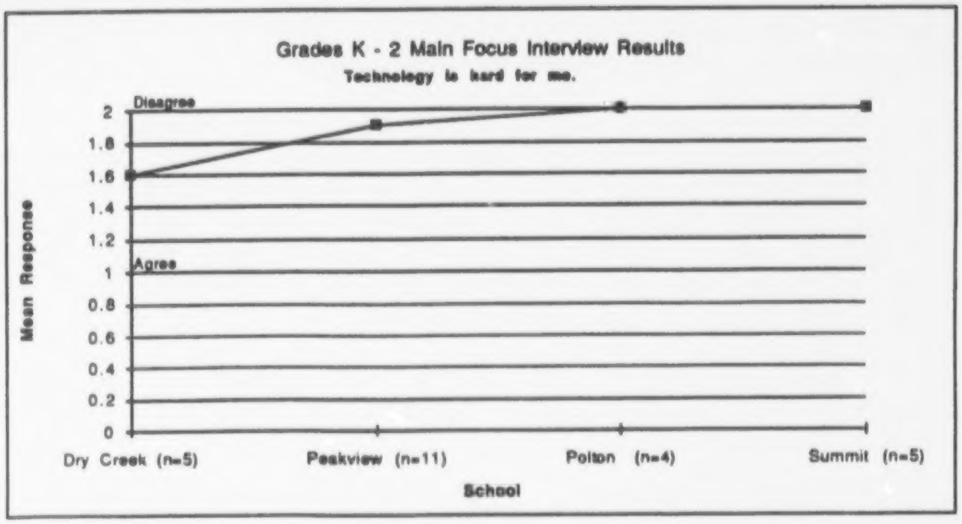
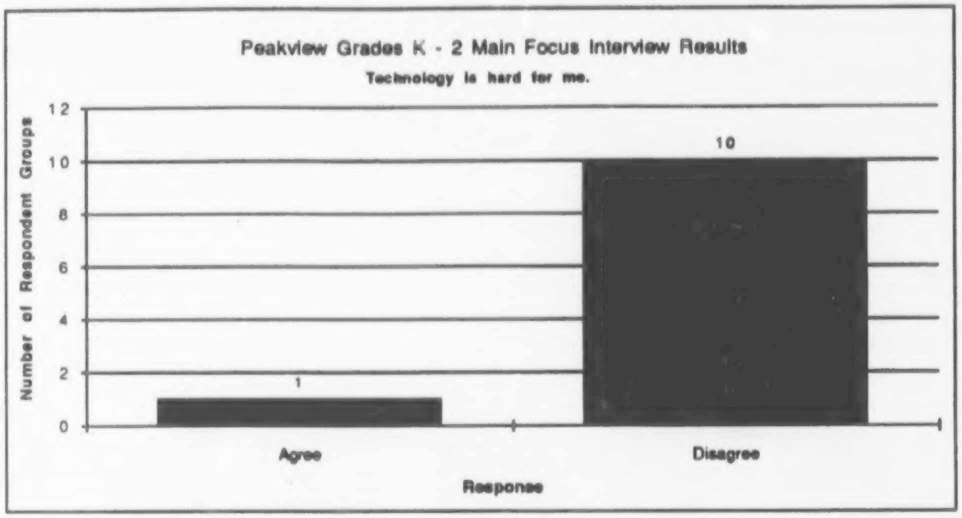

Non-Peakview Grades 3 - 5 Main Survey Results
Technology is hard for me.
Number of Respondents
160
140
120
100
80
60
40
20
0
11
38
131
154
67
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

Figure 91.


Grades K - 2 Main Focus Interview Results
Technology is hard for me.
Disagree
Agree
Mean Response
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dry Creek (n=5)
Peakview (n=11)
Polton (n=4)
Summit (n=5)
School


Peakview Grades K - 2 Main Focus Interview Results
Technology is hard for me.
Number of Respondent Groups
12
10
8
6
4
2
0
1
10
Agree
Disagree
Response

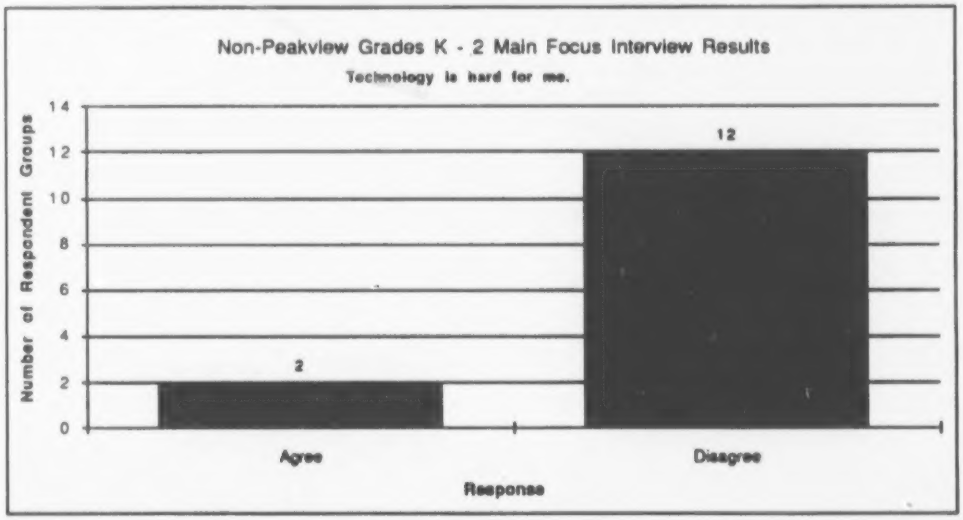

Non-Peakview Grades K - 2 Main Focus Interview Results
Technology is hard for me.
Number of Respondent Groups
14
12
10
8
6
4
2
0
2
12
Agree
Disagree
Response

Figure 92.

Interviews of Peakview intermediate students illustrate the positive effects technology can have on some children's self-concepts:

> *Technology has really been a very good experience for me this year. I've been getting better grades, in which I've been accepted into the G.T. program and I think it's do to the technology because you can learn stuff with technology like laserdiscs, G.T.V., and CD-ROM. I will be going to Thunder Ridge next year and hope I'll have at least on class (not counting computer class) that has at least 6 computers in it like Peakview. I've done some projects without technology and some with it, and it was much easier with the technology.* Charlotte

> *My feeling about technology are...that since so many computers are at Peakview I seem smarter. The computers are like electronic textbooks Except they are tons more fun..* Elizabeth

Intermediate Peakview students, asked in August if they were worried about making mistakes on the computer, responded diversely (Figure 93). The fact that so many students reported concerns about errors suggests that, even for children who view computers as easy and view themselves as good at computers, making mistakes can still be a concern.

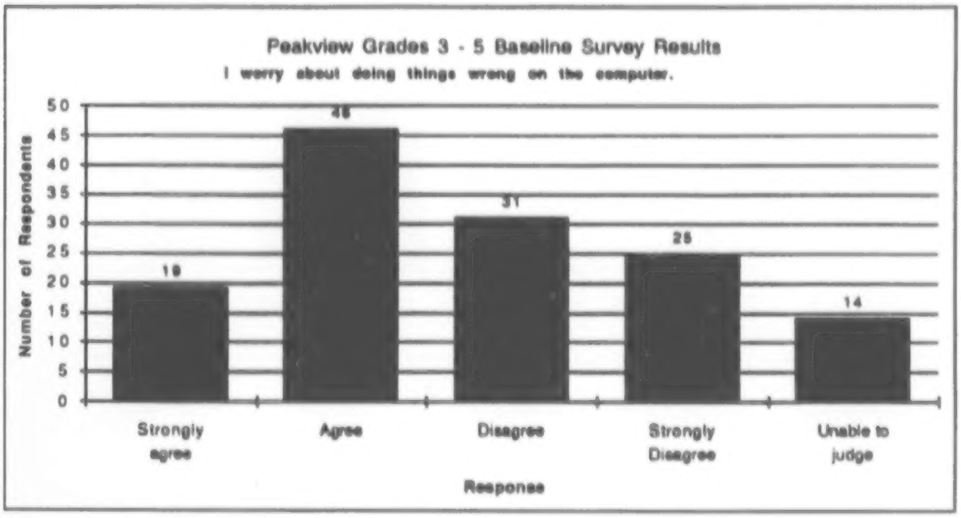


Figure 93.

Here is a typical excerpt from an Peakview student interview with Jeff:

> Do you feel you are good or bad at using technology?
>
> > *Good.*
>
> Are you afraid of making mistakes?
>
> > *No, cause our teachers, they help us edit. First we write on a piece of paper, and then she edits it, and then we write on the computer. Then if we do something wrong, she tells us what's wrong, then we fix it.*

A survey response by a fourth grader further illustrates how many children feel about the technology at Peakview:

> *I used to not be alod to use technology that mach at all. I felt relly dome when I was at my old school. But now I think technology is grand but in a way it is hard. So well I stell love technology and howe it work's.* Heather

In summary, students' self-concepts are affected by a number of factors. Trying to isolate the effects of technology is difficult. The great majority of students view technology as easy, particularly Peakview students. However, a number of Peakview students, at the beginning of the year, reported worrying about doing something wrong on the computer. It seems that there may be some students with concerns about the technology and their confidence in using it.

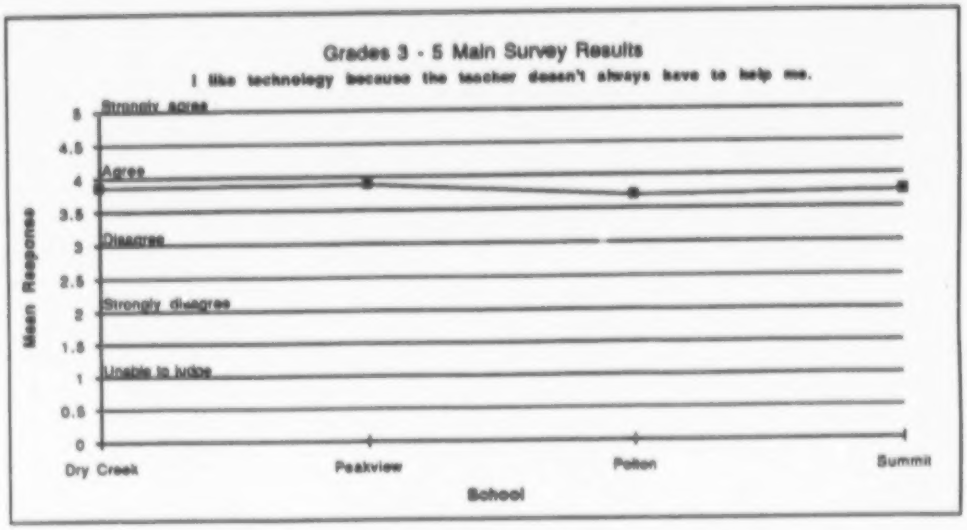
On the positive side, students at all four schools generally agreed that technology make them feel good about themselves. Eighty-six percent of Peakview intermediate students agreed the statement. This indicates a strong number of students whose self-concepts are likely helped by through working with technology.

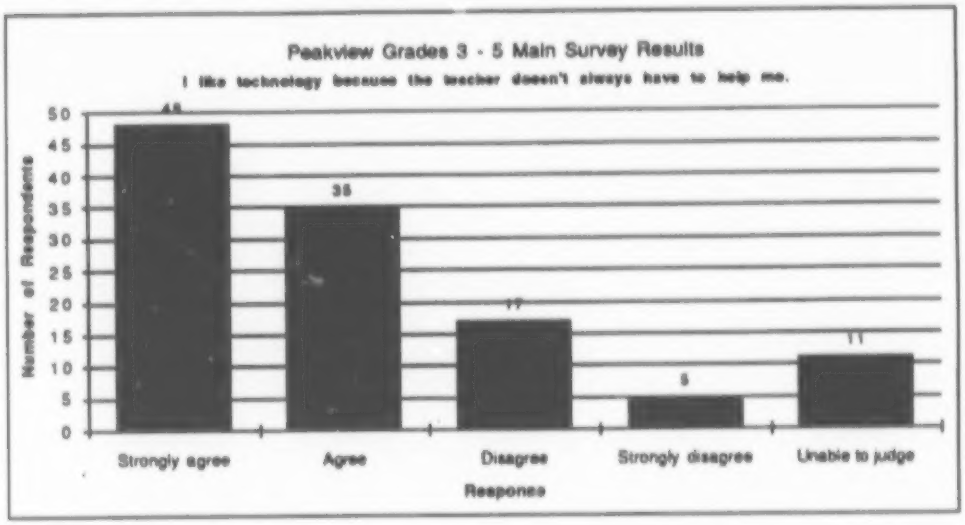
## Student Empowerment

An important educational goal is to help children come to feel in control of their own learning. Taking charge of one's learning—independent of the teacher's behavior and the school environment—is often not entirely achieved until high school. Because technology-based activities can often take the form of independent or cooperative research activities, we were interested in gathering information on this question.

Intermediate students across the four schools generally agreed with the statement, *I like technology because the teacher doesn't always have to help me* (Figure 94). Primary students showed a similar profile of agreement to the statement (Figure 95).

Students generally agreed with the statement *I like to make my own choices about how I use the technology*, although a number of students were "unable to judge" (Figure 96). Primary students at the four schools concurred (Figure 97). Responses were similar to the question, *I like to think of my own ways to use technology* (Figures 98 and 99).


Grades 3 - 5 Main Survey Results
I like technology because the teacher doesn't always have to help me.
Mean Response
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek
Peakview
Polton
Summit
School


Peakview Grades 3 - 5 Main Survey Results
I like technology because the teacher doesn't always have to help me.
Number of Respondents
50
45
40
35
30
25
20
15
10
5
0
48
35
17
5
11
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

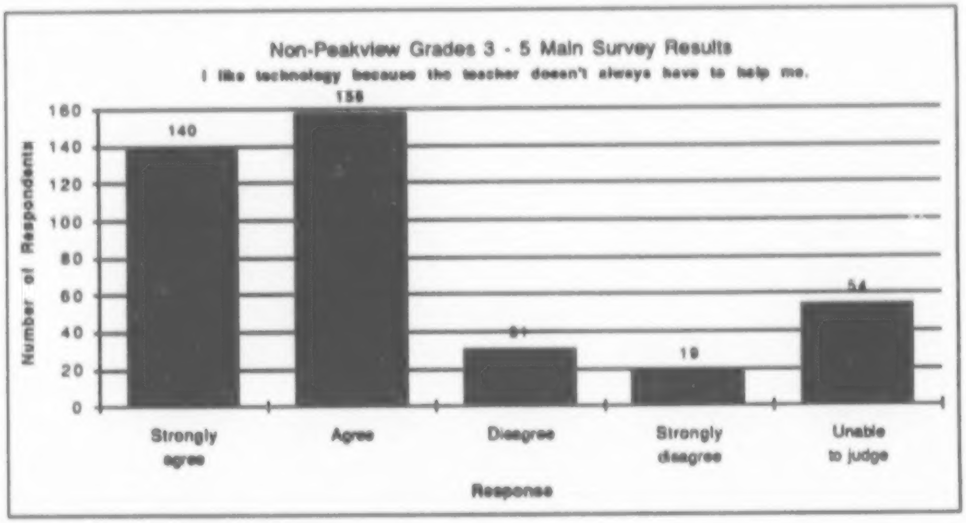
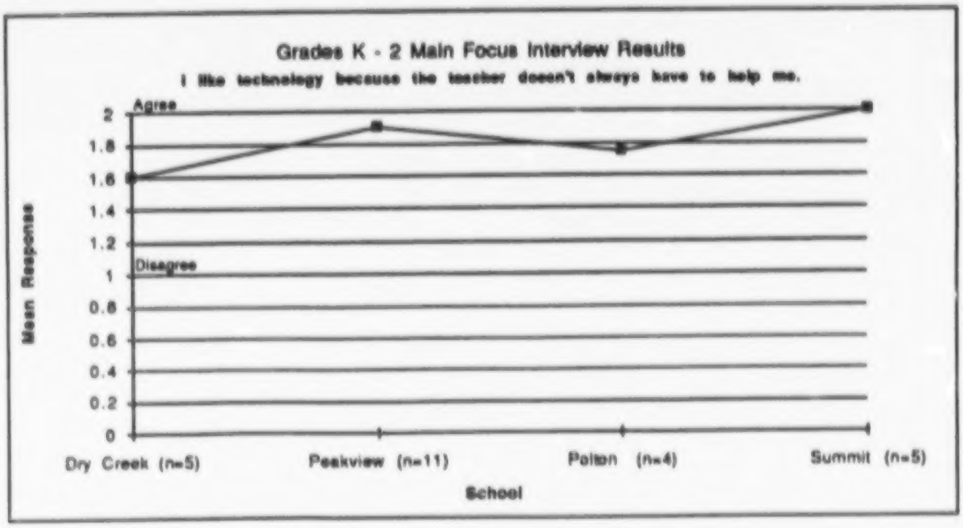
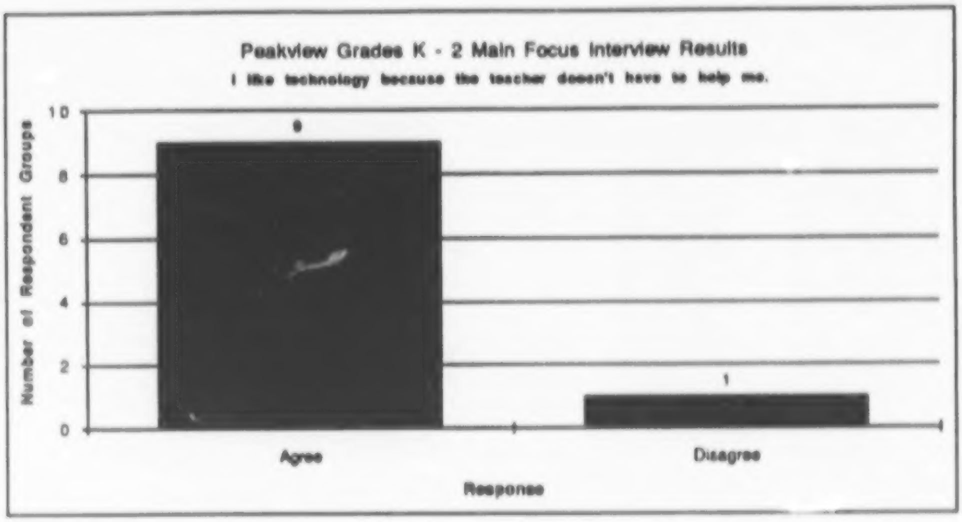

Non-Peakview Grades 3 - 5 Main Survey Results
I like technology because the teacher doesn't always have to help me.
Number of Respondents
160
140
120
100
80
60
40
20
0
140
158
31
19
56
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

Figure 94.


Grades K - 2 Main Focus Interview Results
I like technology because the teacher doesn't always have to help me.
Mean Response
Agree
Disagree
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dry Creek (n=5)
Peakview (n=11)
Pelton (n=4)
Summit (n=5)
School


Peakview Grades K - 2 Main Focus Interview Results
I like technology because the teacher doesn't have to help me.
Number of Respondent Groups
10
8
6
4
2
0
9
1
Agree
Disagree
Response

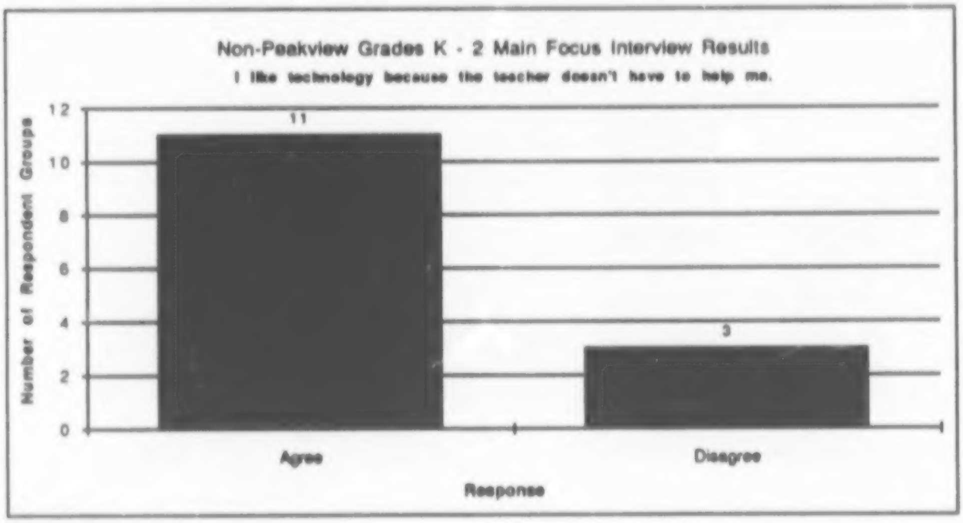

Non-Peakview Grades K - 2 Main Focus Interview Results
I like technology because the teacher doesn't have to help me.
Number of Respondent Groups
12
10
8
6
4
2
0
11
3
Agree
Disagree
Response

Figure 95.

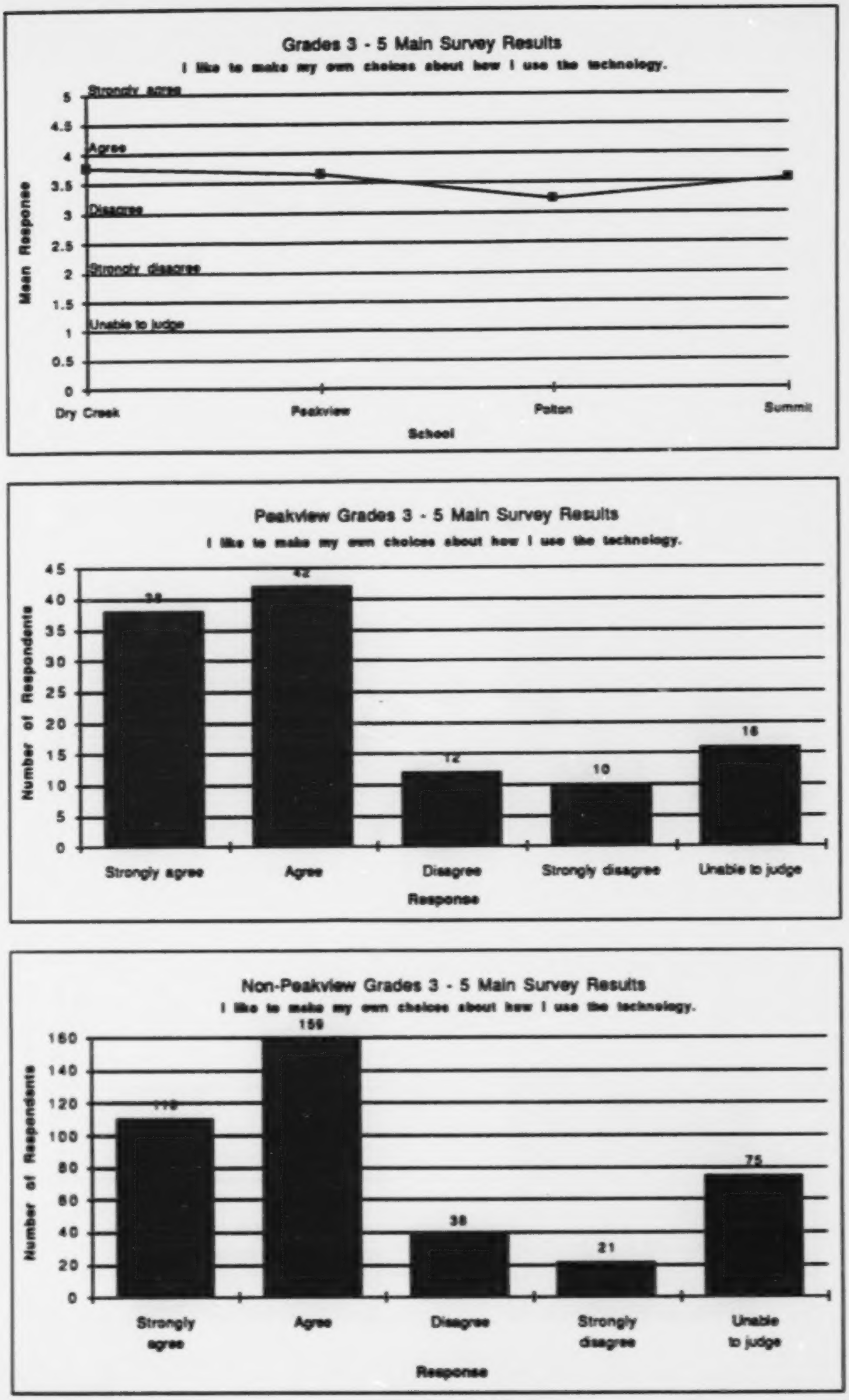
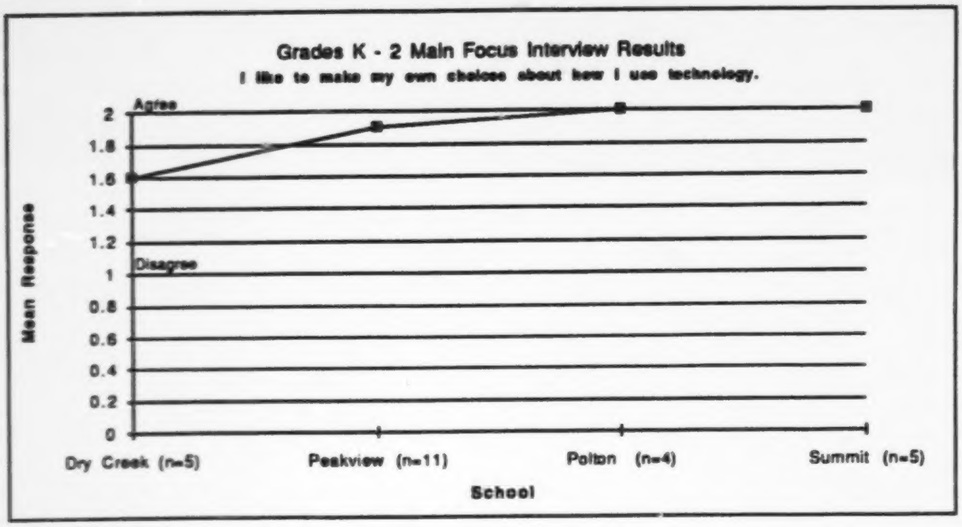
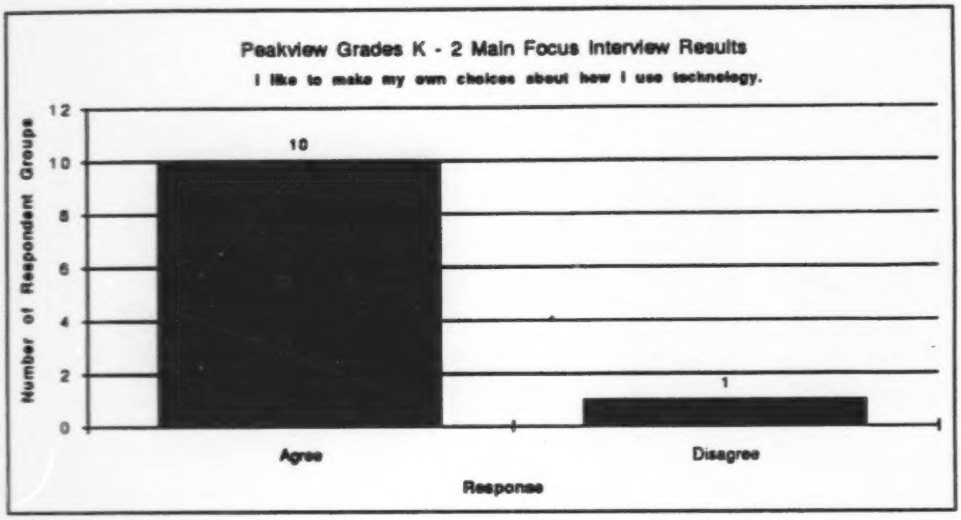

Grades 3 - 5 Main Survey Results
I like to make my own choices about how I use the technology.
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Dry Creek
Peakview
Pelton
Summit
School
Peakview Grades 3 - 5 Main Survey Results
I like to make my own choices about how I use the technology.
Number of Respondents
45
40
35
30
25
20
15
10
5
0
38
42
12
10
16
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response
Non-Peakview Grades 3 - 5 Main Survey Results
I like to make my own choices about how I use the technology.
Number of Respondents
160
140
120
100
80
60
40
20
0
110
159
38
21
75
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

Figure 96.


Grades K - 2 Main Focus Interview Results
I like to make my own choices about how I use technology.
Agree
Disagree
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Mean Response
Dry Creek (n=5)
Peakview (n=11)
Polton (n=4)
Summit (n=5)
School


Peakview Grades K - 2 Main Focus Interview Results
I like to make my own choices about how I use technology.
12
10
8
6
4
2
0
Number of Respondent Groups
10
1
Agree
Disagree
Response

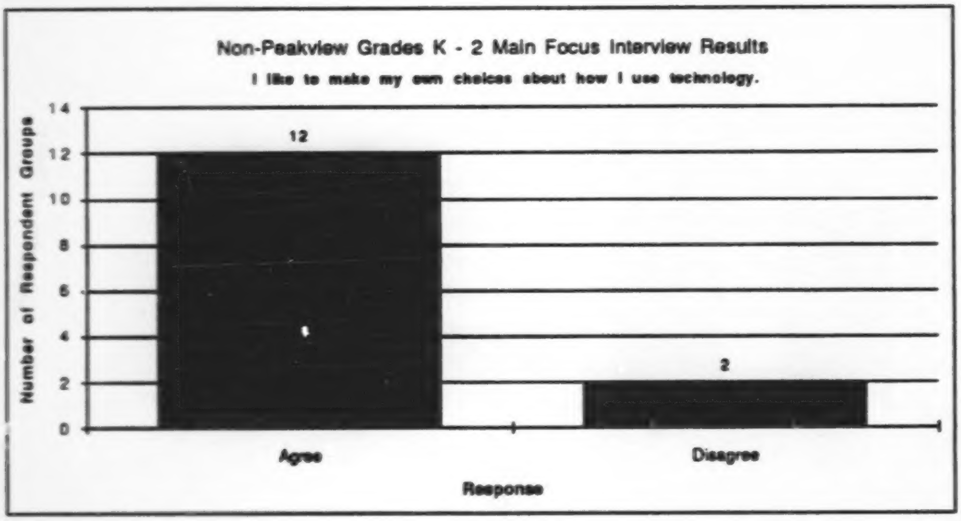
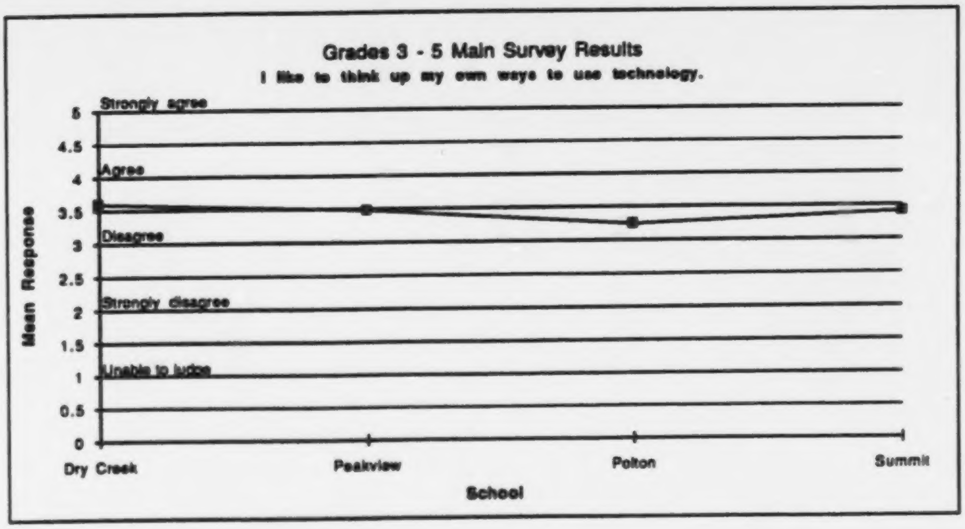
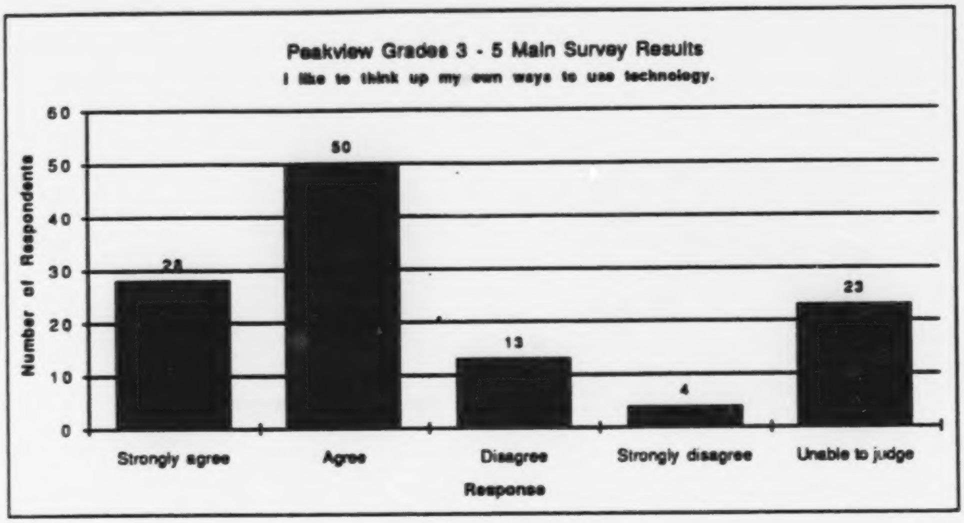

Non-Peakview Grades K - 2 Main Focus Interview Results
I like to make my own choices about how I use technology.
14
12
10
8
6
4
2
0
Number of Respondent Groups
12
2
Agree
Disagree
Response

Figure 97.


Grades 3 - 5 Main Survey Results
I like to think up my own ways to use technology.
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Mean Response
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dry Creek
Peakview
Pollon
Summit
School


Peakview Grades 3 - 5 Main Survey Results
I like to think up my own ways to use technology.
Number of Respondents
60
50
40
30
20
10
0
28
50
13
4
23
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

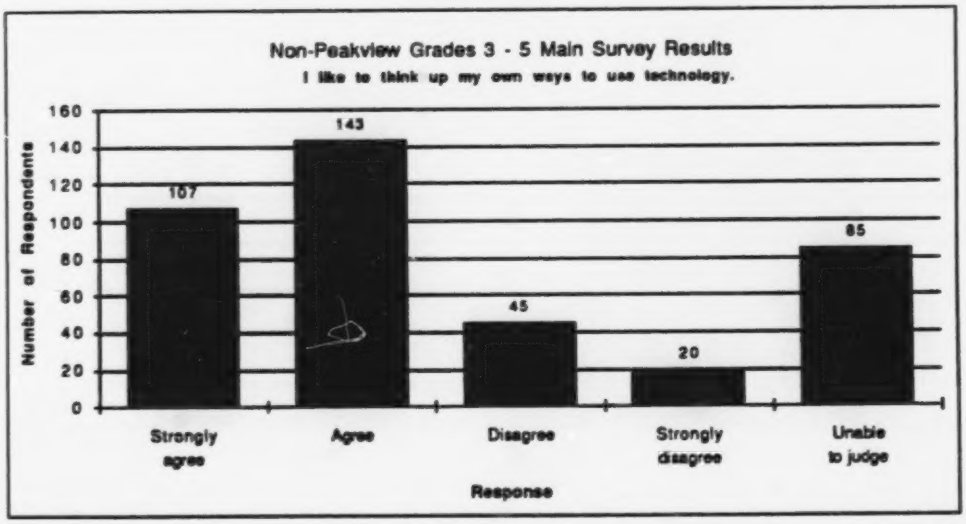

Non-Peakview Grades 3 - 5 Main Survey Results
I like to think up my own ways to use technology.
Number of Respondents
160
140
120
100
80
60
40
20
0
107
143
45
20
85
Strongly agree
Agree
Disagree
Strongly disagree
Unable to judge
Response

Figure 98.

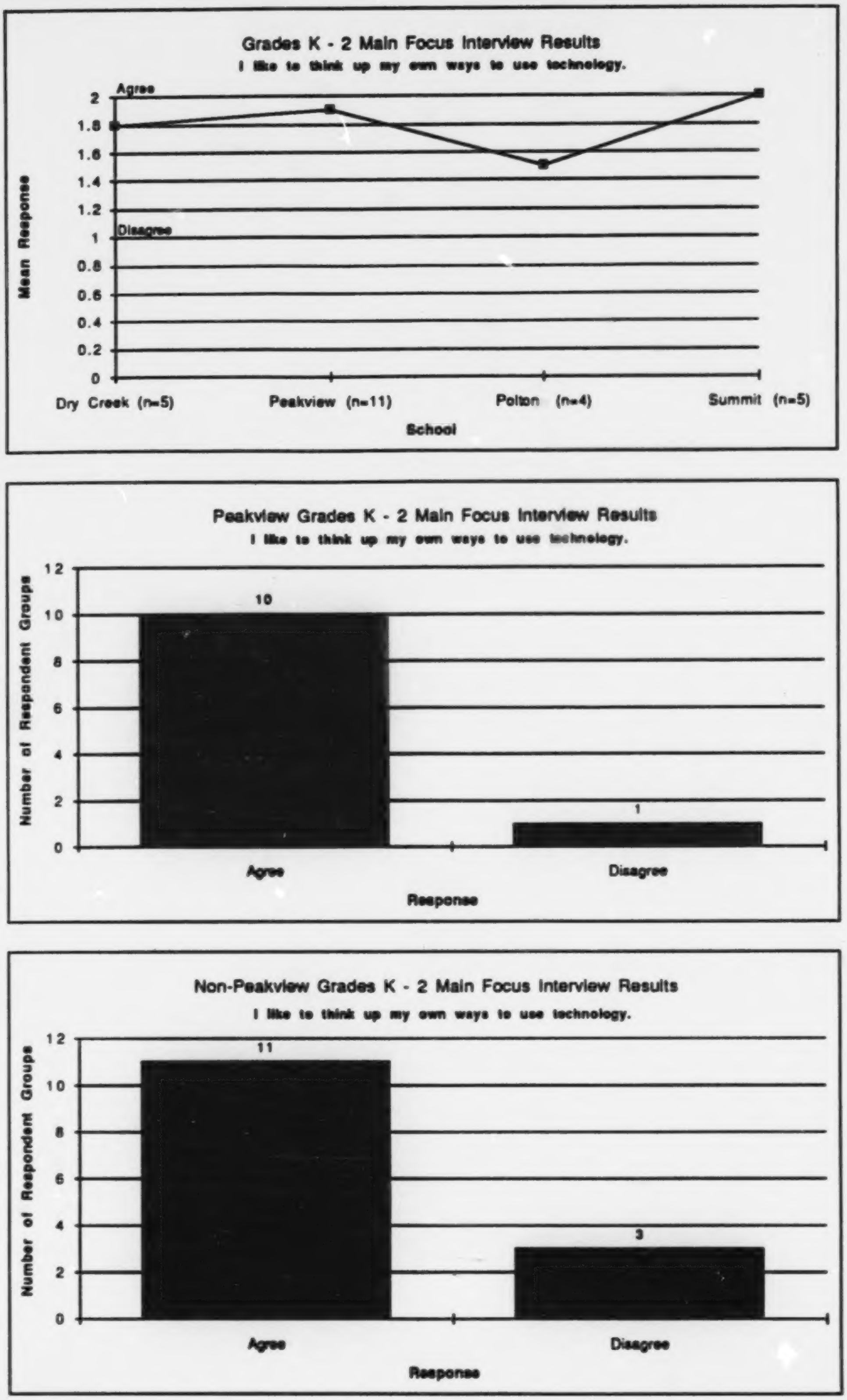

Grades K - 2 Main Focus Interview Results
I like to think up my own ways to use technology.
Agree
Disagree
Mean Response
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Dry Creek (n=5)
Peakview (n=11)
Polton (n=4)
Summit (n=5)
School
Peakview Grades K - 2 Main Focus Interview Results
I like to think up my own ways to use technology.
Number of Respondent Groups
12
10
8
6
4
2
0
10
1
Agree
Disagree
Response
Non-Peakview Grades K - 2 Main Focus Interview Results
I like to think up my own ways to use technology.
Number of Respondent Groups
12
10
8
6
4
2
0
11
3
Agree
Disagree
Response

Figure 99.

## Attitudes of Children With Special Needs

The motivation and attitudes of certain children are especially important when considering educational innovations. For example, if most children had positive attitudes toward a new strategy, but low-achieving children hated it, that finding would be cause for concern, even if the strategy were generally beneficial. Teachers were asked specifically about technology's potential in enhancing the self-esteem of at-risk students. Staff members at all four schools agreed that technology can enhance the self-esteem of these children; Peakview staff members strongly agreed with the statement (Figure 100).

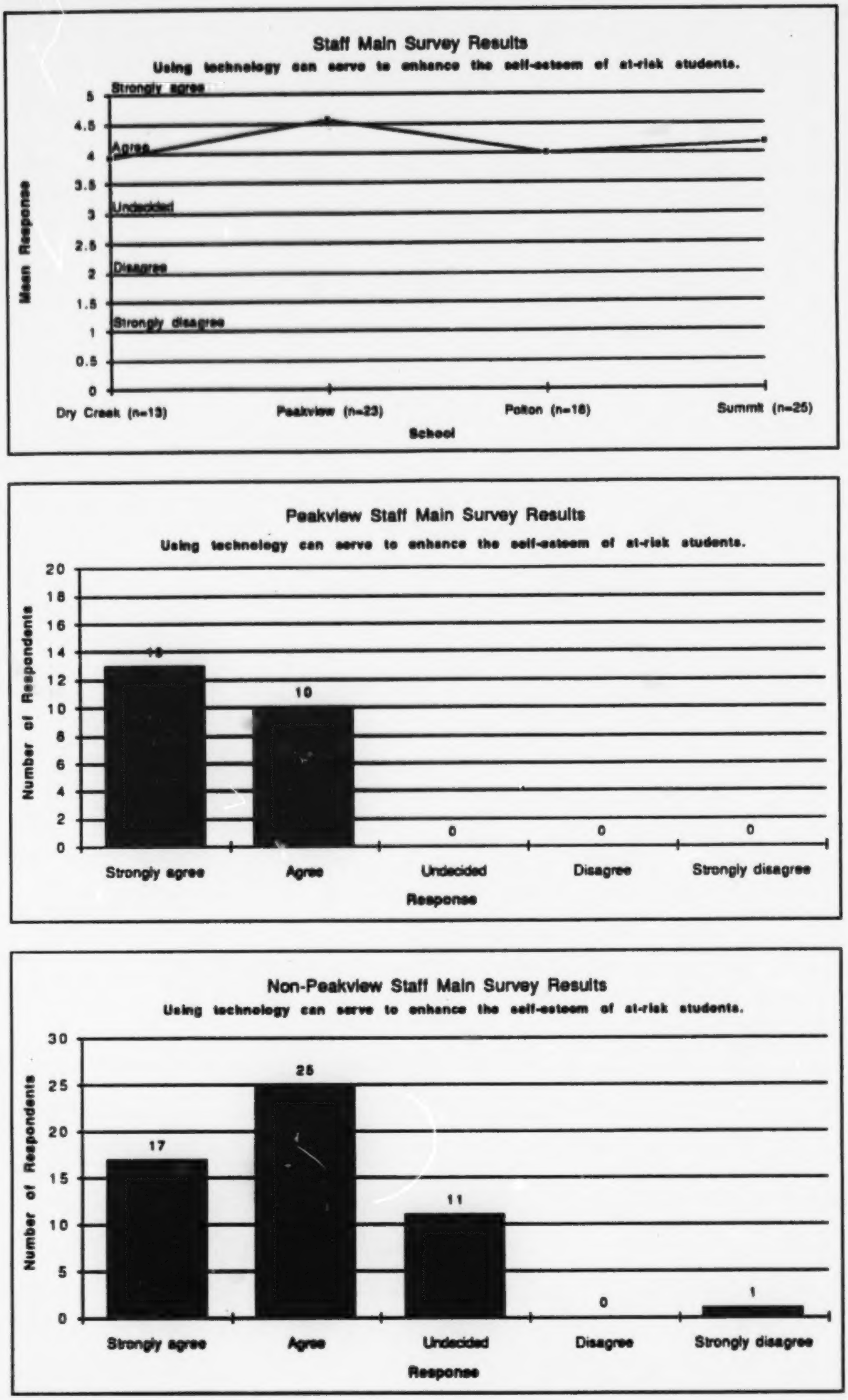


Figure 100.

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Students limited physically seem also to be helped by the technology. One advantage in the ease in interacting with the keyboard for students who have difficulty controlling their fine motor movements. A Peakview special education teacher commented:

> *Technology has changed my life and the lives of my students, almost entirely with positive changes. First of all, most of "my" kids have difficulty with reading and writing, and they are much more motivated by such avenues as computers and laserdiscs to read and write. In writing, for example, students can pull up a variety of pictures for inspiration on the computer, then enjoy the increase of their keyboarding skills and their professional production as they write their stories. For students with fine motor difficulties, who find it hard to produce legible writing the computer opens a whole new avenue of flexible expression.* Gerri, K–5 special education teacher

> *Perhaps what I've noticed the most is the success and growth it gives children when they might not be receiving it from other academic areas. Having a special needs child in my classroom is proof of that. It is through the computer that he is able to choose spelling words, read and follow a book on the CD-ROM and most importantly be able to communicate through a keyboard using pictures and sound. I know that as he continues to use technology he will become more proficient, meaning he will become a better communicator with those around him.* Charlotte, primary teacher

One teacher commented on lower-achieving students and the help technology can be:

> *I have seen "non-readers" become avid consumers of written information. I have seen "non writers", especially those hampered by poor fine motor skills, show tremendous pride in their obvious growth as writers. Kids who, eight months ago, would have run at the mention of research projects, now actively pursue areas of interest ranging from American political figures to zoology.*

In summary, students with special needs are often especially helped by technology. At the same time, teachers need to monitor access to technology to ensure that students of all ability ranges are given full opportunity to use the technology.

## Summary of the Findings

The table below outlines the various effects we have found at Peakview Elementary. The table does not include the strength of evidence for the various findings, but it does provide a handy overview of the various factors affected by technology at the school. Although the study identified a number of areas that need refinement, we could not identify a general impact area where the technology was perceived to have a negative impact.

| Impact of Technology On: | Strongly Positive | Positive | Uncertain | Negative | Strongly Negative |
|---|---|---|---|---|---|
| USE OF TECHNOLOGY | X | | | | |
| Time on technology | X | | | | |
| Use of media | | X | | | |
| Use of hardware | X | | | | |
| Use of multiple modalities | | X | | | |
| Verbal and visual learning media | | X | | | |
| Strategies for equitable access | | X | | | |
| IMPACT ON TEACHING | X | | | | |
| Changes in teacher work | | X | | | |
| Professional uses of technology | X | | | | |
| Ability levels | | X | | | |
| Competition versus cooperation | | X | | | |
| Productive time on task | | X | | | |
| Self-directed learning | X | | | | |
| Accommodating multiple learning goals | X | | | | |
| Accommodating multiple learning styles | X | | | | |
| Students as teachers | X | | | | |
| Information access and research | X | | | | |
| TEACHER ATTITUDES | X | | | | |
| Teacher comfort levels | X | | | | |
| Student perceptions of teachers | | X | | | |
| STUDENT ACHIEVEMENT | | X | | | |
| Basic skills | | X | | | |
| Access and use of information | | X | | | |
| Problem-solving skills | | X | | | |
| Oral and written communication skills | | X | | | |
| Research and reporting | | X | | | |
| Small-group skills | | X | | | |
| STUDENT ATTITUDES | X | | | | |
| Attitudes toward school | | X | | | |
| Attitudes toward technology | X | | | | |
| Attitudes toward learning | | X | | | |
| Attitudes toward teachers | | X | | | |
| Attitudes toward self | | X | | | |
| Student empowerment | | | | | |
| Attitudes of children with special needs | | X | | | |

Table 19. *Summary of the impact of technology at Peakview Elementary School.*

# CONCLUSIONS AND RECOMMENDATIONS

## Conclusions of the Study

1. ***Students and teachers are using the technology.*** The available evidence suggests that the technology is being used heavily at Peakview Elementary. Generally, the kind of use includes word processing, graphics, instructional software, and laserdisc viewing. Students use technology in finding information, researching and writing about topics, and in problem-solving activities.

2. ***Technology is changing classroom practice.*** Peakview teachers overwhelmingly prefer 4–6 computers in the classroom over computer labs. Technology has stimulated innovation in the way subjects are taught; several teachers report adapting their teaching to better integrate technology into different subjects. Other teachers report a desire to continue learning more about the technology, in order to continue changing their classroom practices. Teachers report working more hours because of the technology, and having more control over their work.

3. ***The technology has changed teachers' beliefs and attitudes.*** Peakview teachers underwent an attitude shift in their first year using technology at Peakview. They came to see technology as a powerful tool to facilitate learning in elementary children. They believe that technology can be a vehicle for accomplishing many of the learning and instructional goals that are important to them, such as problem-solving skill, cooperative learning, independent research skills, and individualization according to learners' needs. They have gained confidence in their own abilities to use computers and other technologies.

4. ***Students learn effectively using the technology.*** Students are showing tentative learning gains in a variety of areas. Their skill at using technology is obviously improved. Some teachers report reading and vocabulary improvements in early grades. Students do more editing and revising of written work using word-processing tools. Spell checkers are only sparingly used by students. A number of intermediate students are using the technology for a variety of independent or small-group projects, including:

   - Combining paint graphics and word processing;
   - Incorporating scanned and clip-art graphics;
   - Authoring HyperCard projects;
   - Using CD-ROM and optical laserdisc information references;
   - Incorporated CD-ROM and laserdisc sequences into HyperCard projects.

   Teachers and students report greater student interest and initiative in completing research projects.

5. ***Students are motivated to learn with the technology.*** Students experience increased independence and empowerment as a result of the way technology is used. Teachers report that students work more productively with computers. Student attitudes are positively affected by technology, toward:

    - school,
    - technology,
    - learning, and
    - themselves.

6. ***Technology is a vehicle for many of the school's reform initiatives.*** Multi-aging (having children K–3 in the same classroom) becomes more manageable when technology is used.

    - Process instruction in writing is feasible when editing and revisions can be done on computer.
    - Independent research can be more easily accomplished when electronic forms of references are consulted, and when student data is stored and manipulated on computers.
    - Technology-related projects lend themselves well to cooperative learning groups. Students can collect projects into electronic portfolios, allowing for alternative, authentic assessments of their learning.

    Each of these initiatives is part of Peakview's innovative philosophy of elementary education. There is no question that without the technology, many of these practices would go forward. However, access to the technology improves the likelihood that these reforms will succeed.

7. Key elements of ***successful implementation*** include:

    - ***Computers abundantly available in the classroom.*** Each classroom houses 4–6 color Macintosh computers; computers are often shared between adjoining classrooms to allow more flexible use of resources. According to teachers, the number of computers in the classroom, and teachers' and students' easy access to them, is a powerful factor contributing to successful implementation.

    - ***Shared commitment and vision of school reform with technology as an essential component.*** The amount of work required to successfully begin a school with a number of innovations should not be underestimated. The Peakview community—particularly the teachers and administration—articulated a vision for the school, and they committed to making that vision happen. The entire staff bought in to the program, and worked had to overcome the many obstacles and challenges encountered along the way. An atmosphere was cultivated that encouraged offering mutual support and sharing resources.

    - ***A supportive district and principal.*** Peakview received the support of district administration in developing an innovative set of values and methods for elementary education. The principal supported the use of technology at the school, and enthusiastically learned to use the Macintosh along with the rest of the staff. The leadership and commitment of district- and building-level administrators created conditions conducive to success at the school.

- ***A strong computer coordinator.*** Peakview has one teacher assigned full-time to technology leadership and support. This position seems to be a critical component of the school's implementation of technology. The computer coordinator seems to give other teacher the courage to "charge ahead" in the use of the technology. Hardware and software systems are maintained and managed; inservices are provided to staff and students; troubleshooting help is provided for problems as they arise.

- ***Early and thorough teacher training.*** Before the school opened, teachers received training on Macintosh operating system, *Microsoft Works*, and instructional software to be used in classes. Inservice lessons have been regularly made available to teachers and students. This access to expertise seems to have been very helpful to teachers.

- ***Taking computers home.*** Following initial training in the spring of 1991, each teacher was given a computer to take home for 6 weeks. According to many teachers, this allowed them time to become comfortable with the technology before school started. Many teachers reported receiving tutorial help from their children.

- ***User-friendly systems.*** The color Macintosh LCs at the school have contributed to the attitude change among many teachers. High-quality software is another factor in the school's successful implementation.

## Recommendations to the School

The recommendations in the next two sections arise from the study. In some cases, the recommendations are not closely tied to specific findings, but rather relate to a cluster of different findings and observations. The following recommendations are offered to members of the Peakview community.

1. ***Continue inservice training, particularly informal lessons with teachers and students attending together.*** Teachers are still in a state of rapid growth with respect to their technology expertise. Regular inservice lessons provide them with the opportunity to interact with other people, to pursue new skill areas, and receive help on their problems or areas of concern. There was some indication that frequent, informal lessons with a mix of students and teachers is desirable.

2. ***Train teachers in uses of database, spreadsheet programs, and other tools.*** While teachers and students made good use of word processing, graphics, and instructional software, a relatively smaller number were regular users of database and spreadsheet software. The potential of these programs for both teachers and students justifies future attention in the form of inservice lessons and suggested lesson plans and student activities. As teachers become competent in basic skills, their training may continue in HyperCard authoring, telecommunications, and other areas.

3. ***Continue computer coordinator position.*** Based on the available data, the position of technology resource person or computer coordinator is a criti-

cal ingredient at Peakview Elementary. This position should be viewed as essential for the successful implementation of technology at the school. The computer coordinator will be perceived a success to the extent that s/he serves the Peakview community and provides leadership in technology use.

4. ***Periodically perform a self-study to assess progress, set priorities, spot trends, and establish strategic goals and plans.*** Peakview underwent a substantial self-study as it defined its philosophy and developed its initial plan. The energy invested in such a self-study is well-spent. The school needs to commit to a regular program of self-study in order to maintain its focus on valued priorities. The school should try to systematize a method of collecting evaluative data as a basis for regular review. We recommend that the computer coordinator consider the acquisition of software to regularly track network usage for analysis and maintenance.

5. ***Build regular maintenance and upgrade costs into regular school budget.*** Schools often suffer from a pattern of large and sudden technology expenditures, followed by a long period of benign neglect. In order to continue meeting students' and teachers' technology needs, the school (and district) need to commit to a regular technology budget sufficient to maintain hardware and software, and replace outdated systems.

6. ***Continue developing electronic portfolios and other authentic assessment methods.*** Technology allows a number of ways for students to demonstrate their skill and understanding. Peakview has begun a system of collecting student performance samples into "electronic portfolios." Care should be taken to improve and systematize this effort. Alternatives or complements to the traditional grading system should draw on the capabilities of technology to improve the monitoring of student growth and reporting to parents, the school, and the community.

7. ***Develop improved assessment measures to track performance gains over a period of years.*** Even though the district is the unit primarily responsible for competency assessment, Peakview can cooperate with the district by developing objective measures of student skill and knowledge that can be used to track performance over time. Electronic portfolios (mentioned above) are only one possible type of assessment; others include writing and research project tasks, science projects, and reading tasks.

8. ***Continue to develop electronic-mail (e-mail) and telecommunications capabilities.*** E-mail is rapidly changing the American workplace. Within Peakview, e-mail can be used to further develop the school's sense of community and connectedness. Telecommunications of various kinds can improve communications among teachers and students within the building, as well as outside the building. We encourage the school to develop links between homes and school for teachers and students.

9. ***Continue to cultivate parental involvement.*** Peakview has opened its doors to parents and community members. Examples of this outreach include technology back-to-school nights, computer lessons for parents, and the use of parent volunteers. We encourage the continued use of parent volunteers in technology. This component of the school's philosophy is critical for a number of reasons. Children benefit when their parents are involved

and informed about school activities. And because Peakview's technology-rich environment is an innovation, the community at large needs to be kept informed and educated about it. As the school invests in reaching out to the community, it will see rewards coming back in the form of community and parental support.

10. ***Find more problem-solving software, particularly in science.*** Presently the school's software based is excellent, but it has some gaps. Writing, authoring, and graphics are well-represented, as are basic skills instruction in math and selected subjects. The school needs to seek additional high-quality software to complements its existing base. A variety of problem-solving software in science is social studies is becoming available. We encourage Peakview's consideration of some of these programs.

11. ***Carefully implement cooperative learning activities, ensuring equitable workload among students and efficient use of time.*** Cooperative learning is rightly among the overall goals of Peakview Elementary; furthermore, technology can be a vehicle for effective cooperative learning. We wish to call attention, however, to many students' overall preference for working alone on a computer. Occasionally, students' time in cooperative groups may be inefficiently consumed by tasks unrelated to the assigned task. We encourage teachers to continue engaging students in cooperative learning activities, but to carefully design and monitor those activities to ensure quality learning experiences for all students.

## Recommendations to the District

1. ***Use Peakview as a model for other elementary schools in the district.*** The overall model adopted by Peakview included the use of technology in a way sufficient to cause dramatic effects. Because of this, we recommend that Peakview's approach be considered as a model for the entire district. However, key elements of Peakview's success should not be overlooked, in particular, the consensual method for developing the school's philosophy and careful attention to getting teacher buy-in. The elements identified as key implementation factors should be carefully considered in any attempt to disseminate Peakview's approach to other schools.

2. **Perform a cost/benefits analysis to determine:**

   - **if Peakview technology-related outcomes are highly valued;**
   - **if the value of those outcomes justify the additional cost of the technology.**

   The district needs to decide what kind of education it values giving to students. What kinds of learning outcomes are valued? Do Collins' (1991) learning trends (see literature review above) reflect desired learning goals, or is the district satisfied with traditional conceptions and measures of student learning? The present study provides considerable data that directly bear on this question, but final assignment of worth needs to be made by the district.

   At the same time, the district needs to carefully analyze the costs of the technology within the total context of district expenditures. What percent of the district budget presently goes toward technology? Are there ways to enhance that investment that do not require new revenues? Would the community support revenue increases to fund specifically targeted products and services such as technology? The answers to some of these questions cannot presently be determined, and a careful cost analysis would likely offer valuable some surprising insights that are directly relevant to decisionmaking.

Together, the analysis of the benefits, together with analysis of the costs, should provide a context for making informed decisions concerning the future of technology within the Cherry Creek School District.

3. ***Incorporate objective measures of Peakview's performance into the data provided by the present study.*** Over the long haul, the present study needs to be supplemented with continuing studies of student achievement based on applied performance measures. We recommend that the district analyze student performance on objective achievement measures as they become available over time. Together with the qualitative data offered in this study, performance data will shed further light on the impact of technology within the school.

4. ***Measure student competencies throughout the district.*** The effort described in no. 3 above should be part of a more comprehensive effort to develop a set of performance measures that can be used internally within the district to assess student performance on criterion outcomes. We encourage a general move away from reliance on standardized norm-referenced measures such as the CAT and the ITBS, toward competency measures that more concretely specify key learning outcomes such as writing and communication skills.

5. ***Continue to support Peakview as a prototype lab to try out new technologies and methods.*** The district made a very astute move to support Peakview in its initial use of technology. By creating a technology-rich environment, the school was able to test and evaluate what many teachers throughout the district have desired for many years. We encourage the district to continue supporting technology-rich environments at selected schools. In return, these schools need to commit to rigorously developing disseminable programs, evaluating effects of their innovations, and sharing their experience and expertise with other schools in the district.